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# JOURNAL OF EDUCATIONAL RESEARCH

Official Organ of the Educational Research Association



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JOURNAL *of* EDUCATIONAL RESEARCH

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# UPWARD VERSUS DOWNWARD ADDITION

B. R. BUCKINGHAM
*Ohio State University*

IN a former issue of this journal a discussion of upward and downward addition was published.[1] This article presented data gathered from 493 students, most of whom had had teaching experience. It was shown that approximately three out of five of these students were accustomed to add columns of figures from the bottom up. There was some slight evidence to the effect that those who were without teaching experience exhibited a stronger preference for upward addition than did those who had taught. In fact, among the inexperienced students the vote was more than two to one in favor of upward addition.

Among those who customarily add upward, it was shown that there was less embarrassment in reversing their procedure and less conviction as to the essential reasonableness of their preference. Moreover, it appeared that upward addition was more frequently the product of instruction. In other words, the tendency was apparent, so far as these students might be regarded as typical, for people to adopt downward addition on their own initiative.

Another interesting fact brought out in the discussion to which I am referring was that about 75 percent of the students read expressions like $\frac{5}{3}$ by naming the top figure first. In other words, these students said, "Five and three are eight." While, therefore, a majority of these students added a column of figures upward when the column was tall, they added downward when it was short.

[1] Buckingham, B. R. "Adding Up or Down: A Discussion," *Journal of Educational Research*, 12: 251-61, November, 1925.

The conclusion was that preference for upward addition was not nearly so strong as might be supposed and that the preference for upward addition, where it existed, was not incompatible with a reversal of the movement when occasion arose. The article to which I am referring ended with the following words:

> The real need now is for an experimental attack upon the question to see whether under controlled conditions children learn more quickly and more satisfactorily by one method than by the other. An experiment of this sort is being conducted and may form the basis of a subsequent paper.

The report which follows constitutes the "subsequent paper."

In order that a controlled experiment may be set up, it is necessary to have two comparable groups of children. In each school which participated in this investigation, a class was divided into two sections on the basis of a preliminary test designed to determine fitness for beginning the study of column addition.

Manifestly, so far as number combinations are concerned, the pupil who adds columns of figures will have to know two sets of facts: basic facts and higher-decade facts. Basic facts involve two one-place numbers; for example,

| | | |
|---|---|---|
| 9 | 7 | 4 |
| 2 | 6 | 6 |
| 11 | 13 | 10 |

Higher-decade facts arise from adding a one-place number to a two-place number, such as

| | | |
|---|---|---|
| 31 | 24 | 18 |
| 8 | 6 | 7 |
| 39 | 30 | 25 |

The preliminary test on the basis of which the children in each class were divided into equal-ability groups had two parts. Part I consisted of fifty of the one hundred basic addition facts, and Part II consisted of the remaining fifty facts in higher-decade form. This means, of course, that either in basic or higher-decade form the entire one hundred basic combinations were represented in the preliminary test.

The maximum obtainable score on the preliminary test was 100. The pupil in a class who got the highest score was ranked number one. The pupil with the next highest score received rank two, and so on. Then, for purposes of dividing the class, Pupil No. 1

was placed in one of the groups—say the Upward Group—and Pupil No. 2 in the Downward Group. Pupil No. 3 was then placed into the Downward Group and Pupil No. 4 in the Upward. The arrangement for the first ten pupils in a class was as follows:

| Rankings of First Group | Rankings of Second Group |
|---|---|
| 1 | 2 |
| 4 | 3 |
| 5 | 6 |
| 8 | 7 |
| 9 | 10 |

For purposes of analysis pupils one and two in the above arrangement were regarded as Pair No. 1. They were the pupils having the highest scores in their respective groups and their scores were substantially equal. Similarly, Pupils 3 and 4 who took second rank in their respective groups were known as Pair No. 2, and so on.

The grades in which the experiment was undertaken were sometimes the second and sometimes the third. At first sight this might appear to be an irregularity. As a matter of fact, it was not. The idea was to introduce this experiment at the point where children were beginning to learn column addition. In some schools this was in the second grade while in others it was in the third. It is submitted that no very clear answer can be obtained as to the advantage of one method over another when the children who participate in an experiment have already been taught the subject-matter to which the method is applied. In this experiment the pupils were just beginning column addition when, after taking the preliminary examination, they were divided into two groups of equal ability.

The teachers were directed to devote twenty minutes each day to the teaching of column addition. One of the groups in each class was to be taught to add upward and the other downward. The former was called the Upward Group and the latter the Downward Group. The teachers alternated the time of day at which the two recitations were scheduled. For example, if the Downward Group recited the first week from 10:10 to 10:30 and the Upward Group from 11:00 to 11:20, the groups changed places on the program the second week. They returned to the original schedule the third week; the fourth was like the second; and so on.

All drill and review work was to be done in class and no home work was to be required. During the progress of the experiment no new topics in arithmetic were to be taken up. It was made clear that the whole purpose of the experiment was to determine the difference between teaching downward addition and upward addition. All other factors except this one were to be kept as nearly alike as possible. For example, the same columns for purposes of teaching and drill were to be employed in the two groups.

The duration of the experiment varied in different centers. As soon as the teacher had taught column addition to the point where the pupils were reasonably proficient in adding short columns of one-place numbers, a final test was given and the experiment terminated.

The final examination was in two forms. Form A was to be given to the children who had been taught to add downward. The first five examples follow:

| | | | | |
|---|---|---|---|---|
| 5 | 3 | 1 | 2 | 7 |
| 4 | 5 | 3 | 6 | 2 |
| 3 | 6 | 5 | 4 | 6 |
| 6 | 7 | 8 | 3 | 4 |

Form B was to be given to the Upward Group. The first five examples were:

| | | | | |
|---|---|---|---|---|
| 6 | 7 | 8 | 3 | 4 |
| 3 | 6 | 5 | 4 | 6 |
| 4 | 5 | 3 | 6 | 2 |
| 5 | 3 | 1 | 2 | 7 |

The reader will observe that both groups of pupils encountered the same number facts. The Downward Group, when doing the first example on Form A, had use for the combinations $\frac{5}{4}$, $\frac{9}{3}$, and $\frac{12}{6}$. The Upward Group when doing the first example of Form B used the same combinations. Each form of the final examination consisted of fifty examples similar to the ones just given, and each example on Form B when added upward was the same as an example on Form A when added downward. The score on the final examination was the number of columns added correctly.

Table I shows the scores obtained by seventeen pairs of pupils in a second grade at Center No. 1. It is to be understood that

Pair No. 1 means the two pupils having the highest preliminary scores in the Upward and Downward Groups, that Pair No. 2 means the two pupils having next to the highest scores in their respective groups, and so on.

According to Table I the pupils who were taught downward addition averaged practically four more examples correct than

TABLE I

RESULTS OF TEACHING UPWARD AND DOWNWARD ADDITION AT CENTER NO. 1

| PAIR NUMBER | PRELIMINARY TEST | | FINAL TEST | | DIFFERENCES IN FAVOR OF: | |
|---|---|---|---|---|---|---|
| | Upward Group | Downward Group | Upward Group | Downward Group | Upward Group | Downward Group |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| One | 100 | 100 | 47 | 50 | ..... | 3 |
| Two | 98 | 98 | 48 | 43 | 5 | ..... |
| Three | 98 | 96 | 9 | 35 | ..... | 26 |
| Four | 95 | 95 | 37 | 42 | ..... | 5 |
| Five | 95 | 94 | 38 | 41 | ..... | 3 |
| Six | 88 | 89 | 13 | 21 | ..... | 8 |
| Seven | 88 | 89 | 19 | 48 | ..... | 29 |
| Eight | 88 | 88 | 39 | 10 | 29 | ..... |
| Nine | 88 | 82 | 14 | 47 | ..... | 33 |
| Ten | 74 | 80 | 16 | 8 | 8 | ..... |
| Eleven | 78 | 71 | 7 | 14 | ..... | 7 |
| Twelve | 62 | 68 | 18 | 15 | 3 | ..... |
| Thirteen | 53 | 50 | 7 | 3 | 4 | ..... |
| Fourteen | 47 | 48 | 16 | 3 | 13 | ..... |
| Fifteen | 42 | 42 | 5 | 5 | ..... | ..... |
| Sixteen | 25 | 39 | ..... | 3 | ..... | 3 |
| Seventeen | 17 | 9 | 1 | 13 | ..... | 12 |
| Average | 72.7 | 72.8 | 19.65 | 23.59 | ..... | 3.94 |

did those who were taught to add upward. It is possible to investigate the reliability of this difference by means of the formula for the probable error of a difference:

$$PE_{\text{diff.}} = .6745\sqrt{\sigma^2_u + \sigma^2_d - 2r\sigma_u\sigma_d}$$

In this formula $r$ is the correlation between the scores of members of each pair on the final test, $\sigma_u$ is the standard error of the mean of the Upward, and $\sigma_d$ is the standard error of the mean of the Downward Group. Since $r = +.60$ and since the values of $\sigma_u$ and

$\sigma_d$ are respectively 3.73 and 4.29, the probable error of the difference is 2.62. Accordingly, the difference, amounting to 3.94, is 1.5 times its probable error. This means according to our present theory of reliability that the chances are five to one that the experiment, if done over again under similar conditions, would yield a result favorable to downward addition.

Similar experiments were tried in six other centers with results as indicated in Table II. This table shows data for 122 pairs of children, distributed among seven centers, as shown in Column 2. The average number of columns correctly added is shown for each

TABLE II
SUMMARY OF RESULTS AT SEVEN CENTERS

| Center | Number of Pairs of Pupils | Average in Final Test | | Difference in Favor of: | | Probable Error of Difference |
|---|---|---|---|---|---|---|
| | | Upward Group | Downward Group | Upward Group | Downward Group | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1 | 17 | 19.7 | 23.6 | ..... | 3.9 | 2.6 |
| 2 | 16 | 35.5 | 40.3 | ..... | 4.8 | 2.9 |
| 3 | 20 | 39.3 | 44.6 | ..... | 5.3 | 0.8 |
| 4 | 13 | 47.4 | 47.7 | ..... | 0.3 | 1.4 |
| 5 | 28 | 34.1 | 35.7 | ..... | 1.6 | 2.0 |
| 6 | 17 | 40.7 | 35.7 | 5.0 | ..... | 2.4 |
| 7 | 11 | 38.8 | 43.0 | ..... | 4.2 | 2.8 |

center in Columns 3 and 4 and the differences are shown in Columns 5 and 6. The Downward Group did better than the Upward Group at all centers except No. 6. Some of the differences, however, are insignificant. The one for Center No. 4, amounting to .03 is quite too small to mean anything. Nevertheless, we ought to point out in this connection that most of the twenty-six pupils at this center turned in perfect final papers. The averages of 47.4 and 47.7 reflect this fact. Under such circumstances we are justified in saying that the final examination constituted no test of the adding ability of these pupils.

The most significant difference shown in Table II is that for Center No. 3 where the Downward Group surpassed the Upward Group by 5.3 examples correct with a probable error of 0.8. This

unusually low probable error arises partly from the high correlation found to exist between the paired measures on the final test at this center. The *r*-value was +.97, indicating that the preliminary test which was used as a basis of pairing was highly satisfactory, at least at this center. It will be noted that the difference at Center No. 3 is more than six times its probable error.

The next largest difference was at Center No. 6 where the advantage lay with the Upward Group to the extent of 5.0 problems correct. This would practically offset the difference of 5.3 found for the Downward Group at Center No. 3 were it not for the fact that the difference at Center No. 6 is considerably less reliable, being about twice its probable error.

Of the six differences presented in Table II one is in favor of upward addition and amounts to a little more than twice its probable error. All the rest of the differences favor downward addition. Four of these differences in favor of downward addition are at least 1.5 times their probable errors. As already indicated in connection with Table I this means that the chances are five to one that the experiment, if repeated under the same circumstances, would yield results favorable to the teaching of downward addition.

Any conclusions with respect to the superiority of downward addition must in strictness be limited to the conditions of the present experiment. The limitations of the final test are particularly to be noted. It consisted, as has already been shown, of fifty columns of four one-place addends. One is inclined to inquire whether the verdict would have favored downward addition had the examination been more exacting.

Perhaps it is unwise to speculate, although practical school people will for a long time have to continue to go beyond the strict interpretation of scientific data. There is at least one reason to believe that if the final test had been more comprehensive the advantage for downward addition would have been still more pronounced. Since the columns were all short, the eye and hand at the conclusion of the upward addition were not far from the place where the sum was to be written. If the columns had been longer the eye and hand would have been obliged to travel much further in passing from the point at which the addition was completed to

the point where the answer was to be written. One of the arguments advanced on *a priori* grounds for downward addition is that it brings the hand and eye to the point where the answer is to be written thereby reducing the likelihood of error. It is clear that this argument, so far as it applies at all, applies to an increasing degree when columns are long.

Perhaps there is a second reason why we might expect a more extensive final examination to yield results even more favorable to downward addition. If the examination had involved columns of two-place numbers so that carrying was required, the extra movements of eye and hand involved in upward addition might be expected to give rise to greater errors when adding was done in that direction. If the reader will write a column of five or six two-place numbers and note the movement of eye and hand in upward addition he will find that there are at least two more movements than are required when the same example is added downward. (This is assuming that the pupil writes the number he has to carry.) With the fewer movements required by downward addition, it is perhaps not unreasonable to suppose that a final test which involved carrying would exhibit results even more favorable to downward addition than those which this experiment yields.

Even as matters stand, we feel that the results strongly indicate the wisdom of teaching children to add downward. When the verdict at seven different centers is six to one in favor of this method it is nothing more than good management to follow the figures where they lead.

# A TECHNIQUE FOR MEASURING THE EFFICIENCY OF SUPERVISION

L. J. BRUECKNER
*University of Minnesota*
AND
PRUDENCE CUTRIGHT
*Director Instructional Research, Minneapolis Public Schools*

ONE of the major problems of school administrators is to evaluate the efficiency of supervision. Practically all communities now employ supervisors of various types, but there is little scientific evidence as to the value of the work which they do. Supervisors employ many techniques, but little is known as to their relative efficiency. Some supervisors are mere inspectors who make routine visits to the classrooms but do little constructive work. Others merely demonstrate the various methods of teaching different subjects and expect teachers to imitate their techniques. Still others carry out carefully planned supervisory programs, in which a variety of methods are used.

As far as the writer knows, no one has yet reported an attempt to measure the changes in teaching techniques due to supervisory efforts. The effects of supervision have been almost entirely measured in terms of growth of pupils, as measured by standardized tests. It is the authors' purpose to report an attempt which was made in Minneapolis during the present year to improve the efficiency of the teaching of reading in the elementary schools, as well as to measure the effectiveness of supervision. The effectiveness of the program is measured not by the results of standardized tests, but by observed changes in classroom practice due to the supervisory program.[1]

A scheme by which to collect the information regarding current practices was necessary, since no technique for this purpose was available. After a period of preliminary experimentation, the most feasible procedure found was to make a study of the different types

[1] It will not be possible here to discuss the complete development of this program. Any one interested in securing a detailed statement of it is referred to the pamphlet, *The Technics and Evaluation of a Supervisory Program for the Improvement of the Teaching of Work Reading*, recently published by the Board of Education of Minneapolis.

of lessons in terms of the objectives. Preliminary experimental work showed that it was possible for a group of individuals to observe a lesson in reading and to determine the major objectives through the nature of the activities carried on during the lesson. To facilitate such analysis, a detailed list of the commonly accepted objectives of reading was prepared, and each was supplemented by comments to explain it.

Horn, Anderson, Gray, and others have divided the objectives of reading into two groups; those concerned with reading for study purposes and those with reading for recreatory purposes. The first type is called "work reading," and the second type, "recreational reading." The part of the Minneapolis program which is here reported is concerned with the study of work reading.

When once it had been decided that the basis of the supervisory program in Minneapolis should be a study of the objectives of work reading, the next question was how to secure, in the most economical and effective way, the desired information concerning current teaching practices in the elementary grades. Since eighty-four elementary schools were to be included in the survey, it was obvious that the investigation could not be made by a single group of trained supervisors from the main office. Moreover, it was felt that the participation in the survey should be as widespread as possible. For this reason, the survey of reading objectives was made by the principals of the buildings. To insure a clear understanding of the problem before the survey and a thorough knowledge of the techniques to be used, the principals were given preliminary training in the selection of the objectives. A set of mimeographed descriptions of lessons was prepared; and, during a special meeting, the principals were asked to read the lessons carefully and select the major objective of each lesson. As a guide in this activity, the principals were given a list of objectives. A high percent of agreement in their selection of objectives was found. A similar result was obtained from classes in supervision at the University of Minnesota, where perfect agreement regarding the objectives of some lessons was shown, while on a few lessons there were differences of opinion, due likely to the inexperience of the untrained supervisors. As has been pointed out, the objectives of lessons in the classroom are easily determined except in cases where

the lesson lacks an apparent objective. This does not invalidate the technique which was used in this survey, but rather raises the question of the efficiency of the teaching. Lessons without a definite objective are not as satisfactory as those in which an objective is easily discerned.

Each principal followed this practice meeting with a short period of observation in his own building. The teachers then were asked to prepare lessons which they thought demonstrated their most effective types of work reading. Only one lesson for each teacher was to be observed in order to secure a cross section of current practices. On a special card (see Figure 1) prepared for

STUDY OF READING OBJECTIVES MINNEAPOLIS PUBLIC SCHOOLS

School Hyde Park Grade observed 3 B Room 10 6

Length of period in minutes 35 Did you observe the entire lesson? yes

Number of pupils in instructional group 16 Otherwise engaged 17

1. Indicate by number the major objectives or aims of the lesson

10 c 10 d 31 7c

2. List books and materials used. Nature Study Reader Book II

3. On the back of this card list the chief reading activities of this lesson.

(1800 10-28 V)

Figure 1. Principal's record of each lesson's objectives

the purpose, the principal indicated the objective of the lesson, using the code number which corresponded to the number given to each of the objectives in the summary shown in Table I. In addition to this, a record was made of the material used in the lesson and the types of activities which were carried on. At the end of the survey, these cards were sent to the research department, and the data were tabulated.

The first survey was followed by a series of special bulletins on different phases of the teaching of reading on which the teachers wished help. A series of demonstration lessons for each grade were given on the types of reading not stressed according to the results of the first survey. The city was divided into districts, and

## TABLE I

### A Comparison of the First and Second Survey of Study of Reading Objectives

| Objectives in Work Reading | Number of Lessons Reported | | Percent of Lessons Reported | |
|---|---|---|---|---|
| | First Survey | Second Survey | First Survey | Second Survey |
| (1) | (2) | (3) | (4) | (5) |
| I. In which silent reading predominates— | | | | |
| A. *Ability to locate material quickly requires:* | | | | |
| 1. Knowledge of and an ability to use an index | 30 | 54 | 4.8 | 8.7 |
| 2. Ability to use a table of contents | 11 | 27 | 1.7 | 4.4 |
| 3. Ability to use the dictionary | 20 | 11 | 3.2 | 1.8 |
| 4. Ability to use a library file | 1 | 2 | .1 | .3 |
| 5. Ability to use reference material | 10 | 24 | 1.6 | 3.9 |
| 6. Ability to use maps, tables, graphs | 4 | 17 | .6 | 2.7 |
| 7. Ability to skim | 102 | 67 | 18.0 | 10.8 |
| Total | 178 | 202 | 30.0 | 32.6 |
| B. *Ability to comprehend quickly what is read requires:* | | | | |
| 8. The establishment of rhythmic and rapid eye-movement | 22 | 2 | 3.5 | .2 |
| 9. The elimination of lip reading and vocalization | 17 | 3 | 2.7 | .5 |
| 10. Acquiring a vocabulary of accurate meanings | 122 | 48 | 19.6 | 7.7 |
| 11. The habit of vigorous reading | 40 | 2 | 6.4 | .2 |
| Total | 201 | 55 | 32.2 | 8.6 |
| C. *Ability to select and evaluate material needed:* | | | | |
| 12. Judging the validity of information | 2 | 6 | .3 | 1.0 |
| 13. Choosing ideas from different sources which explain or supplement one another | 2 | 9 | .3 | 1.4 |
| 14. Discovering different ideas in different sources | | | | |
| 15. Deciding whether a given question is answered | 9 | 37 | 1.4 | 5.9 |
| 16. Ability to sort essential and nonessential statements | 4 | 11 | .6 | 1.7 |
| 17. Telling what questions are answered by material | 14 | 22 | 2.2 | 3.5 |
| 18. Finding the solution of a problem | 21 | 44 | 3.3 | 7.0 |
| Total | 52 | 129 | 8.1 | 20.5 |
| D. *Ability to organize what is read:* | | | | |
| 19. Practice in picking out central ideas | 31 | 26 | 5.0 | 4.2 |
| 20. Practice in selecting main topics | 54 | 69 | 8.8 | 11.0 |
| 21. Practice in outlining | 48 | 99 | 7.7 | 15.9 |
| 22. Practice in summarizing | 11 | 12 | 1.7 | 1.9 |
| Total | 144 | 206 | 23.2 | 33.0 |
| E. *Ability to remember what is read:* | | | | |
| 23. Practice in selecting things to remember (see ability to organize) | 10 | 11 | 1.6 | 1.8 |
| 24. An understanding of the best way to memorize | | | | |
| 25. An understanding of the necessity for overlearning | | | | |
| 26. Practice in remembering | 6 | 4 | .9 | .6 |
| Total | 16 | 15 | 2.5 | 2.4 |
| F. *A knowledge of the best sources of materials:* | | | | |
| 27. Practice in selecting the proper reference books to gain an answer | 1 | 2 | .1 | .3 |
| Total | 1 | 2 | .1 | .3 |

TABLE I—*Continued*

| Objectives in Work Reading | Number of Lessons Reported | | Percent of Lessons Reported | |
|---|---|---|---|---|
| | First Survey | Second Survey | First Survey | Second Survey |
| (1) | (2) | (3) | (4) | (5) |
| II. Oral reading | | | | |
| A. *A knowledge of what makes oral reading effective:* | | | | |
| 28. Pupils formulate a statement of the things which make oral reading effective | 2 | 3 | .3 | .5 |
| 29. Pupils discuss why the oral reading of certain directions or announcements was not effective | 1 | ..... | .1 | ..... |
| 30. Pupils practice to make their oral reading more effective | 8 | 4 | 1.2 | .6 |
| Total | 11 | 7 | 1.6 | 1.1 |
| B. *Ability to select material which is pertinent to a given oral reading situation:* | | | | |
| 31. Selecting and reading to the group material to prove a point under discussion | 2 | 1 | .3 | .2 |
| Total | 2 | 1 | .3 | .2 |
| C. *Skimming in preparation for oral reading:* | | | | |
| 32. Children discuss and illustrate the difference between reading unfamiliar and familiar material | 1 | ..... | .1 | ..... |
| Total | 1 | ..... | .1 | ..... |
| D. *An understanding of the purpose to be served by the reading:* | | | | |
| 33. Practice in reading material to serve different purposes | ..... | 2 | ..... | .3 |
| Total | ..... | 2 | ..... | .3 |
| E. *Ability to recognize and pronounce all the words in a selection:* | | | | |
| 34. Phonics | 1 | 2 | .1 | .3 |
| 35. Word analysis | 1 | ..... | .1 | ..... |
| 36. Drill on lists of words commonly mispronounced | 3 | 1 | .4 | .2 |
| 37. Using the dictionary to secure the correct pronunciation of a word | 2 | ..... | .3 | ..... |
| Total | 7 | 3 | .9 | .5 |
| F. *Ability to use the voice in a pleasing effective way:* | | | | |
| 38. The habit of noting the effect of a pleasing voice upon an audience | ..... | 1 | ..... | .2 |
| Total | ..... | 1 | ..... | .2 |
| G. *Ability to interpret the thought of a selection accurately:* | | | | |
| 39. Practice in reading selections to give different interpretations | 2 | ..... | .3 | ..... |
| Total | 2 | ..... | .3 | ..... |
| H. *Proper attitude toward an audience:* | | | | |
| 40. Practice in reading announcements | 2 | ..... | .3 | ..... |
| 41. Practice in reading directions for making things | ..... | ..... | ..... | ..... |
| 42. Practice in reading informational material which the rest of the group wants to know | 3 | 2 | .4 | .3 |
| Total | 5 | 2 | .7 | .3 |
| Grand total | 620 | 625 | 100.0 | 100.0 |

all teachers were expected to attend these meetings. There were model lessons in training pupils to select and evaluate what they read and in ability to organize what had been read. These were taught by teachers who volunteered their services. Many local meetings were held by principals. A number of reading specialists, such as C. J. Anderson and G. T. Buswell, were brought to the city by the teachers' organizations to discuss different aspects of the problem; and the schools supplied themselves with the best available literature on the subject. There were numerous special demonstration lessons by teachers in individual buildings. Special talks were given by members of the research department, and the attention of all the teachers within the system was focused on this problem during the period of special study.

After this period of training, a resurvey was made in which the same scheme was repeated. Teachers again taught lessons which they thought illustrated their most effective types of work reading on which the principals, in turn, made their reports. The results of this investigation are shown in Table I. On the first survey, 620 lessons were reported and on the second, 625. The table contains a distribution of the lessons with each of the reading objectives reported on both surveys. The second column gives the number of lessons with each of the specific objectives reported on the first survey; the third column contains the same data for the resurvey; and the last two columns show the percents of the total number of lessons in each survey. The totals and percents are also given for each major ability.

An analysis of Table I shows that there were some interesting shifts in the teaching of reading in the interim between the surveys. For example, in the first survey there were 178 lessons whose objective was one of those listed under the heading the *Ability to locate material quickly* (IA). In the resurvey there were 202 lessons which had one of these objectives. These totals are respectively 30.0 and 32.6 percent of the lessons reported. While the total number of lessons with this objective remained almost the same, an analysis of the distributions for the specific abilities listed under this heading shows a considerable shift. For example, the percent of lessons on the "Ability to skim" decreased from 18 to 10.8; lessons on the "Ability to use the index" increased from

4.8 percent to 8.7 percent. Other variations also can be noted. There was a decrease in the number of lessons having as their objective the *Ability to comprehend quickly what is read.* On the first survey 32.2 percent of the lessons reported had this objective, on the resurvey only 8.6 percent. This shift can be explained by an analysis of the data for the next two headings. The number of lessons whose objectives were to develop the *Ability to select and evaluate material* increased from 8.1 to 20.5 percent; and the lessons to develop the *Ability to organize what is read,* from 23.2 to 33.0 percent of the total. This shift shows clearly the effect of the special demonstration lessons which were given during the training period. Most of the lessons during the period of demonstration were illustrations of these special objectives, because of the relatively small use of them reported in the first survey. This change in emphasis may be considered a direct measure of the effectiveness of the supervisory program.

The remainder of the table shows that there has been practically no other change. The distribution of lessons on the objectives of oral reading were about the same on both surveys. This also can be explained, since the demonstration lessons in the training period did not touch oral reading.

The information which has been collected does not give any evaluation of the improvement in the techniques of teaching reading. It merely shows the objectives of the lessons the teachers taught after a period of training. From casual observations and from comments by principals, however, a decided improvement in the methods of teaching has been found. Lessons now are usually taught with more clean-cut objectives. A much wider use is being made of the content material in history and geography, as a means toward the development of special reading abilities; and there has been a direct transfer of the effects of this supervisory program to the teaching of the social studies. Stress is being given to the development of proper study habits. Many schools are preparing sets of drill exercises for developing various aspects of each ability. Primary teachers are devising seat work which will give training in the basic elements of each skill. The program of work reading is to be followed by a similar period of intensive study of the factors which are involved in recreational reading.

The technique which was used in making the survey has certain limitations. The picture of the teaching of reading secured through the survey may not reveal the real status, since teachers were asked to teach lessons which they thought were their best. It is possible, therefore, that this distribution of lessons is not typical, although this is doubtful because of the large number of lessons that were reported. It may be of interest to know that surveys in a number of smaller cities of the State of Minnesota yielded a distribution of objectives similar to that found on the first survey in Minneapolis.

This technique also does not evaluate the efficiency of the teaching itself. It merely gives a picture of what, in the judgment of the principal, were the major objectives of the lessons observed. It does not show, for example, whether the teaching was skillfully done, whether the material that was used to achieve the objective was well selected, or whether the pupils increased in ability under the training given. Means can be developed which will make this information available, but it cannot be secured with the technique here employed.

The survey did not measure other desirable outcomes adequately. For instance, no measurement was given of the increased knowledge of available reading materials which the teachers had acquired. The reports showed that principals were almost unanimously of the opinion that the teaching of reading had greatly improved during the period of special study.

The outline of objectives may not be adequate, since there are undoubtedly lessons in which other types of reading abilities are developed that are desirable; very few, however, were reported. The increased stress upon work reading may have resulted in a lack of attention to recreatory reading. To offset this, the schools at the present time are engaged in a special study of the objectives and techniques of the teaching of such reading.

The values of the technique that was employed are numerous. The procedure which was used made it possible to collect a great deal of information in a short time with resulting economy in effort for the supervisory group. In this survey the contacts with the procedure included large numbers of people. The conditions under which this distribution was made were as carefully controlled as

possible. The cycle plan of supervision, used in Minneapolis, made it possible to focus the entire school organization on the special study of one problem.

By the use of this technique supervision was made objective. The supervisor's attention was focused upon problems of classroom procedure and its improvement. When needs were revealed, he could proceed using the facts gathered as the ground for his changes. The effects of supervisory activity were also measured in objective terms.

By this scheme the principals are able to help the teachers evaluate their own work. This is done by asking them to check on the list the objectives which governed the lessons taught during a certain period. The teachers in one school are asked to report each week the objectives of their reading lessons.

This technique suggests the possibility of developing methods for measuring the teaching of other subjects. Undoubtedly, the method used in this survey can be used for subjects such as history, geography, and arithmetic. The facts of the survey made clear the places where training was necessary and provided a reliable basis for the supervisory program.

The technique developed in Minneapolis can be applied to the requirements of any community and the instruments will be thoroughly usable. The chief problems connected with such a survey are: the careful organization of the program; the devising of the instruments and devices used in collecting the information; the training of those who are to make the survey; the preparation of bulletins and outlines for study during the period following the survey; the selection of the types of the work to be done during the period of teacher training; and the arrangement of demonstration lessons.

# THE TRAINING OF COLLEGE TEACHERS

F. J. KELLY
*University of Minnesota*

WE appear to be passing through the early stages of a widespread movement for the better adaptation of graduate schools of arts and sciences to the work of training college teachers.[1] The training of college teachers has always been accepted as one of the primary functions of the graduate school. On the basis of scattered studies of the occupations of university graduates, it is conservative to estimate that well over 75 percent of those granted Ph.D. degrees in this country go into teaching. That the graduate school is not doing that important service as well as has been commonly supposed, is a conviction which has been forcing itself these last few years upon a rapidly growing number of friends of graduate schools.

Demands for a careful study of the graduate school as a teacher-training institution are being heard from all parts of the country. Wilbur L. Cross, dean of the Graduate School of Yale University, in a paper read before the 1925 meeting of the Association of American Universities, pleaded for a new type of requirement for the Ph.D. degree—a type of requirement determined by the broad training demanded of the undergraduate teacher as contrasted with the highly specialized training of the investigator. Said Dean Cross:

> The program of the graduate school is likely, I should say, to mold itself with the college teacher more clearly in view; while the university institutes at the same time draw upward the investigators with whom teaching is but a side issue. The time would seem to be ripe for art to step in to the assistance of nature. The two general classes of students within the graduate school, namely, prospective teachers and prospective investigators, may perhaps go on together for a period which can never be quite fixed; but, at some variable point there should be a differentiation so that each class may go its own way.

Demands for better adaptation of graduate schools to their teacher-training function are coming in considerable volume from

[1] Read before the National Society of College Teachers of Education at Dallas, Texas, February 28, 1927.

the colleges. Perhaps the best spokesman for this group is Leon B. Richardson, a professor of chemistry at Dartmouth, who was commissioned by President Hopkins to study the colleges in this country and in England. At the end of a year's study, he wrote a most stimulating report, one chapter of which is devoted to a discussion of the training of the college teacher. The penetrating analysis which the author makes of the graduate school reveals not only its elements of great strength as a place for specialists, but also clearly points out the major causes of the complaints leveled against it as a teacher-training school. One sentence may serve to show how keenly Professor Richardson feels about the situation in graduate schools: "We may even go farther and conclude that no part of our educational system is in greater need of reappraisement, of examination of purpose and method, or reorganization in view of the needs of the times."

Deans of graduate schools and college professors are joined by students in the demand for humanizing the training given in graduate schools. The recent over-emphatic statement of the Harvard student which has been widely quoted is a striking example of such criticisms. In a recent study by the writer, some five hundred alumni and as many Seniors, in a dozen of America's better colleges bore testimony that the chief faults with methods used by college teachers were those growing out of a lack of interest in students and student problems of study and learning.

While it cannot be said that this growing volume of criticism has stirred graduate schools as a whole very deeply, there is clear evidence that self-analysis is taking place in many quarters and that significant changes are on the way. As an expression of one group, ready to pin its faith to courses in education as the cure, the resolution adopted in 1922 by the Land-Grant College Association is worthy of note. Two clauses of this resolution stated: "That the Association of Land Grant Colleges declare this year in favor of professional training of college teachers" and "That, beginning with 1925, candidates for positions (teaching) in land-grant colleges be required to have at least six semester hours of professional training, including courses in educational psychology and methods of teaching. As soon as practicable this requirement should be increased."

A year ago, Dean John W. Withers, of the School of Education of New York University, announced new requirements for the Ph.D. degree which are designed especially for prospective college teachers. The chief characteristics of the new requirements are that about a third of the three-years graduate study is to be devoted to professional courses in education and in apprentice teaching and that the thesis is to be in some phase of college, university, or professional education "with the intention that the studies made shall contribute to the improvement of teaching and administration in higher education."

Many institutions—notably Teachers College, of Columbia University—have organized courses in the field of higher education. These courses are available, although nowhere required so far as I know, to those who are planning to be college teachers.

A questionnaire study, in which three hundred colleges and universities participated, was reported recently by Dean Otis W. Randall, of Brown University, at a meeting of the Association of American Colleges. Thirty-six of the participating universities which have graduate departments answered affirmatively the question: "Does your institution make any serious effort to train teachers for college work?" What form these serious efforts take will be revealed in a forthcoming report of a committee of the North Central Association of Colleges and Secondary Schools, of which professor W. E. Smyser, of Ohio Wesleyan, is chairman. I have been permitted to look through the replies from deans of graduate schools to the question, "Has anything been done to promote the investigation of the problems of college education in your institution? If so please give details." While it is not fitting that I should indicate the nature of the committee's findings before their report is made, I am sure the committee will not mind my expressing delight at both the number and variety of these activities already going on.

Probably no more need be said to carry conviction on two points. First, there is a widespread feeling that training for college teaching should be more seriously undertaken in graduate schools than it now is; and, second, the movement has already started which is bound to lead to the necessary changes. If these two points be accepted, then our most important job for the next decade or two

is to help guide the movement so that we may arrive at the goal with the least delay and with a minimum of zigzagging. The remainder of this paper will be devoted to a defense of three propositions, agreement upon which would, in my judgment, do most to forward the sound reorganization of graduate schools as teacher-training institutions.

First, a new curriculum, dictated by a new objective, must be put side by side with the present curriculum, and both must lead to the same degree, Doctor of Philosophy. Many persons hailed the resolution of the Land-Grant College Association, part of which was quoted in a preceding paragraph, as a victory for the professional training of college teachers. In one respect, of course, it was. Members of that Association acknowledged publicly that college teaching is not efficient. However, to conclude that incorporating educational psychology and methods of teaching in the present curriculum of graduate schools will constitute a cure for inefficient teaching, is to miss the main point. Where change is needed is in the essential spirit which dominates graduate schools.

So far as I know, educational literature contains few illustrations of cases where a graduate faculty has undertaken a critical analysis of what the graduates are expected to do when they enter undergraduate colleges as teachers. Certainly, not many graduate schools have determined the requirements for the Ph.D. degree on the basis of problems which holders of the degree will meet as college teachers. Intensive specialization and capacity for independent investigation are the characteristics of the requirements leading to a doctorate. The undergraduate-college teacher, on the other hand, requires the broadest possible training; the development of a wide variety of interests; recognition of what evidences constitute proof of truth; an understanding of the essential laws of learning—with the resulting ability to devise the best procedures in teaching; and, finally, a sympathetic interest in the lives and problems of the youths who come to him for guidance in their college work. What graduate faculty, if it seriously analyzed the problems which face an undergraduate-college teacher, would conclude that our present graduate curriculum is satisfactory?

We have hidden behind two assumptions, neither one of which is entirely sound. In the first place, we have said that a teacher

is born and not made; in the second place, we have said that anyone who knows his subject can teach it. Many of the essential attributes of a good teacher are personal and therefore cannot be transmitted by instruction, but, there are all degrees of these attributes, and no one who is acquainted with psychology will deny that these attributes develop in a favorable atmosphere and tend to atrophy in an inhospitable atmosphere. Furthermore, it will be conceded that much can be done in the way of substituting more effective pedagogical devices and procedures for less effective ones and therefore overcome, in a measure, the handicap suffered by the absence of certain personal qualities.

It would seem unnecessary to spend time in refuting the second statement that anyone who knows his subject can teach it. Few people have gone through college without coming under the instruction of the type of college teacher who knows his subject but seems to have no regard for the difference in intellectual level between himself and his undergraduate students. Nor does he seem to appreciate the necessity of organizing his material in such a way that the students can master it. Usually it is this type of teacher who wags a sarcastic tongue and takes pride in the large number of failures in his course. He has never seriously considered the purpose of his course as a liberalizing influence in the lives of his students.

What is most essential is to give respectability to the art of teaching in the minds of graduate-school faculties. To do this there must be established a curriculum, the requirements in which are determined by the fact that it is preparing for college teaching. Investigations will help to reveal the proper content of that curriculum. Undoubtedly, however, its essential characteristics will be these: broader fields of study to replace the present intensive specialization; ability to study independently and effectively so as to assure keeping abreast of the developments in one's field to replace the present demand for ability in research; participation in seminars dealing with problems of college education to build up a body of knowledge about college education and to develop an *esprit de corps* among them as prospective college teachers; and, finally, to provide opportunities for learning those essential principles of teaching which are applicable on the college level.

Second, the spirit of investigation into problems of college teaching and administration must come to permeate the undergraduate college. At a recent holiday meeting of the American Association for the Advancement of Science, three sessions of the section on education were devoted to twenty-one papers giving the results of investigations into problems of college education. Encouraging progress is being made both in respect to the number of persons engaging in such investigations and in the academic and professional standing of those investigators. There is growing a body of scientifically derived information about college education which will, when in the hands of scholars who are sympathetic with the necessary readjustments in college organization and teaching, be effective in convincing the college world. This movement for investigation also, therefore, is on the way. The important question now is: What are the essential principles which should operate to guide it? I wish to indicate two.

While it is acknowledged that the technique for conducting these investigations must, for some time at least, be expected to be known chiefly to those trained in the field of education, the actual investigation should be made on the initiative, or at least with the active cooperation, of college teachers in the various subjects. Wherever possible the origin of the project should lie with the college teacher rather than with the student of education. The education department should, in general, be in the position of assistant or counsel or to the men in the academic departments, but the responsibility for the investigations ought to lie with the academic teachers.

In order to foster a proper spirit of investigation a committee on research in college problems should be created in every institution. This committee could help to coordinate the various interests and could bring to the problems which arise for investigation the sound technique of education.

Probably the most useful thing I can do in discussing this proposition is to outline what has transpired at the University of Minnesota in the last three years. Growing out of a report made by a special committee on vocational guidance, a committee of deans and members of the faculty of the University of Minnesota was appointed under the general title of Committee on Educational Research. The chairman of this committee is the Dean of the College

of Education, M. E. Haggerty, but the rest of the members are from the other schools and colleges of the University. This committee has no administrative responsibility and is free to conduct investigations into any question concerning teaching or administration in the University, making its report directly to the President.

As one would naturally suppose, the committee has worked through a considerable number of subcommittees, membership on which has not been confined to members of the original research committee. A committee on student personnel devised a form for the assembling of information concerning students which has since been adopted in most of the schools of the University. A committee on evaluating extra-curricular activities of students has made an exhaustive investigation and is about ready to submit its report. A committee investigating the relative success of instruction in large and small classes has enlisted the cooperation of a large number of faculty members who have conducted experiments under the most rigid conditions and have checked the results by the best scientific procedures known. This committee has made several partial reports and is rapidly bringing its final report to conclusion. A committee on the teaching of science is at work, the main point of inquiry being whether the higher cost of the laboratory method is justified in the case of the large numbers of elementary-science students. It has been both gratifying and surprising to note how widespread the interest has become among the members of the faculties in the many science departments. Small investigations, testing out the relative effectiveness of two students versus four students to a cadaver in anatomy and five hours a week versus seven and a half hours a week of laboratory in medical physiology, were immediately begun and preliminary reports have already been submitted upon them. At a meeting of the committee where a report was given, more than sixty members of the faculty, mostly science teachers, attended and showed keen interest in the result.

The general effect of the work of the Committee on Educational Research, at the University of Minnesota, has been to stimulate in a quite remarkable way the spirit of experimentation on all manner of questions relating to college teaching. These investigations are usually proposed by members of the academic departments. Assistance is often given by members of the Department of Education;

and, in several cases, graduate students in education now are cooperating with the academic departments and using the material for theses. There is a growing hospitality on the campus to the idea that it is worthy of a college teacher to examine critically his methods of teaching. In fact, some are ready to acknowledge that it requires scientific standards just as exacting to examine educational procedures involved in college organization and instruction as it requires to attack an original problem in science or in the humanities. If, and when, such a sentiment generally prevails on the campus, the battle for better training of college teachers will have been largely won.

Third, courses in education, except those basic ones in psychology and principles of education, should be built upon the results of such experimentation as have recently been conducted, and will be conducted, into the field of collegiate education.

One of the things I most fear, in this rapidly growing movement for the better training of college teachers, is that graduate schools may be lead to accept the idea that departments of education can be called upon to give professional training to prospective college teachers and that these departments of education will make moderate revisions in their present courses and offer them as training for the professional side of the preparation of college teachers. To be sure, there are many common elements between proper instruction in college, and proper instruction in the high school or the elementary school. These courses will fail of their function, however, if they are not made up quite largely of the results of actual experimentation which are adequate to prove the soundness of the recommended procedure. It is far better to leave present practices as they are than to advocate changes, the soundness of which cannot be clearly demonstrated. Any man is entitled to his own opinion that the college is more in need of fundamental reorganization than is any other unit of our educational system. I happen to share that opinion myself with reference to a good many features of college education. Nevertheless, I do not believe that we have a right to ask prospective college teachers, trained in the exacting requirements of high scholarship, to accept our dictum unless that dictum is backed up by the kind of proof which will carry conviction to their trained minds.

One of the most common arrangements spoken of by deans of graduate schools as a method used in training prospective college teachers, is that whereby assistants, fellows, scholars, and the like—registered in the graduate school and doing part-time teaching—are, in a sense, apprenticed to the more mature members of the department. It is assumed that they learn much concerning proper teaching methods from the professors in charge of the work. Without doubt there are many places where that is true. The practice rests on an assumption, however, which I think cannot, in general, be defended. It assumes that a department head, or some other member designated by him, is qualified to give these apprentices or younger members of the staff the proper training in teaching. Such department heads are usually not selected because of their qualifications as teachers. They have made their reputation in the field of research; and their primary interest is not what the young assistant does as a teacher, but what he does as a prospective investigator. If the graduate school definitely accepts its responsibility for training teachers and selects from each one of the major departments an outstanding teacher in whom is placed the responsibility for supervising the apprenticeship work of the younger members of the staff, then, of course, effective work may well be expected. It must not be forgotten, however, that the main reason for the appointment of assistants, fellows, and scholars is either to make it possible for these students to pursue their graduate work by virtue of the financial subsidy or to procure instruction at the least possible cost. This list of assistants, therefore, naturally includes a great many young men and women who are themselves not interested in teaching, but who are, instead, interested in research. If the system of apprenticeship is thought of as a part of the teacher-training plan, these assistants and fellows should be divided distinctly into two groups and only those who are going on to teaching should be permitted to do this apprenticeship work.

To summarize, it seems sure that a brighter day is coming in the training of college teachers. The first and foremost need in ushering in that brighter day is a clear recognition by the graduate schools that one of their principal functions, if not the principal function, is to train college teachers. This will involve a fundamentally different sort of curriculum than now prevails in the

requirements for a degree of Doctor of Philosophy. The second essential of this movement is the development of a spirit of experimentation and investigation on the part of college faculties themselves, in order that there shall grow up a body of definitely proved material in the fields of college organization and teaching. In the third place, it is necessary that, in the professional aspects of teacher training, the education courses should develop out of the new experimental material which is developing and should not be "warmed-over" courses from the field of elementary and secondary education. Apprenticeship teaching should take place under the supervision of only thoroughly trained and recognized college teachers.

# TEST AND HIGH-SCHOOL RECORDS AS INDICATORS OF SUCCESS IN AN UNDERGRADUATE SCHOOL OF BUSINESS

ARTHUR W. KORNHAUSER
*University of Chicago*

IN the present study an attempt is made to evaluate and compare high-school records and test data for students entering the School of Commerce and Administration of the University of Chicago at the beginning of the academic years 1921-22, 1922-23, 1923-24, and 1924-25. The central question considered is: How successfully do high-school marks and test scores help in appraising student abilities and in predicting scholastic standing? The predictive data to be compared consist of an index of high-school marks, scores on intelligence tests, a reading test, and a high-school information test.

High-school averages were reduced to a comparable basis for the different marking systems of the several high schools by expressing each student's standing as a ratio—

$$\frac{\text{Student's average} - \text{Passing mark of the school}}{100 - \text{Passing mark of the school}}$$

These ratios fall between 0 and 1.00. The University of Chicago requires that this percentage mark must be at least .25 for all students admitted. In the case of high schools which use a letter-marking system, the letters were transmuted into numbers by means of keys showing equivalent marks. About two-thirds of the present data are from Chicago high schools.

The intelligence tests used were: in 1921-22, Army Alpha; in 1922-23, Otis Self-Administering Test of Mental Ability, Higher Examination; in 1923-24, the Otis test again and also the Terman Group Test of Mental Ability; in 1924-25, the American Council on Education tests. The reading test used in the first three years is an unpublished test of reading comprehension ability devised by the writer. It consists of ten paragraphs, each followed by a set of five statements. The student is asked to check those statements which contain an idea that is in the paragraph or can be derived from it. Part of this test was incorporated in the 1924 examination published by the American Council on Education. Scores on this

adaptation of the reading test were used for our Freshmen of 1924. The remaining test, the Iowa High School Content Examination, devised by G. M. Rueh, was used only in 1923-24. It consists of 115 questions on high-school material, divided into sections as follows: Section 1, English, literature, etc.; Section 2, mathematics; Section 3, science; Section 4, history and social sciences.

As a measure of scholastic achievement in college, average grades have been used. While these marks are far from being a satisfactory criterion of college success, nevertheless their use appears justified in that they probably constitute the most important and reliable single measure of achievement at present available. Almost without exception, marks are employed as the one significant measure used in college administration to indicate degrees of academic success. Even where other information is available the scholarship ratings are almost always the basic data; other indicators of ability are secondary and supplementary.

The marking system in use during the years covered by this study provided the following marks:

| Letter Rating | Value in Grade-Points |
|---|---|
| A | 6 |
| A— | 5 |
| B | 4 |
| B— | 3 |
| C | 2 |
| C— | 1 |
| D | 0 |
| E | —1 |
| F | —2 |

An average of two grade-points (C) is required for graduation.

In the particular data with which we shall deal, the marks have a distinct advantage over those usually employed, because the curriculum is more or less uniform for all students. Thus, the average marks for the first year, which we shall use most, are normally based on nine courses, six of which are required of all Freshmen. In the main, the same is true of the second year. As a result of this uniformity, that part of the unreliability which arises from the fact that some students take "easier" courses than others, is largely eliminated.

An indication of the statistical reliability of the marks may be given by means of a few correlation coefficients. In the freshman

year, the marks of one quarter correlate with marks of a different quarter to an extent expressed in coefficients ranging from .40 to .70. First-year averages and second-year averages in the groups studied correlated .68. As reliability coefficients, these figures are by no means high. Fortunately, however, we need not accept them as a true picture of the actual reliability we are interested in, since the lowest section of entering students is not included in the calculations. The lowest 10 to 15 percent of Freshmen, according to first-quarter marks, do not continue in school and hence are not represented in the reliability coefficients, but it is in this extreme group that marks are probably most trustworthy and most significant. When we evaluate judgments of students by comparing them with first-year marks, we include the first-quarter records of those who went no farther. Our data consequently have a considerably wider range than the marks used in obtaining reliability coefficients, and their reliability is correspondingly greater. Hypothetical reliability coefficients can, in fact, be calculated which show how well marks would agree from quarter to quarter if the wide range which is present in the first quarter were to continue through later quarters. The coefficients thus figured[1] run from .65 to .83.

### CERTAIN CORRELATIONS OF THE TESTS AND HIGH-SCHOOL AVERAGES

The results obtained in 1921, 1923, and 1924 agree closely, but the data for 1922 show some decidedly different relationships. We can merely point out the discordant results secured in 1922, without being able for the most part to account for the differences.

In all the years except 1922, correlations with first-year scholarship were closest for the reading test; the intelligence tests came next; and the high-school averages last. In 1922, the order was precisely the reverse and the test coefficients were strikingly different in size. The correlation figures are given in Table I.

[1] These coefficients are obtained by means of the formula

$$\frac{\sigma}{\Sigma} = \frac{\sqrt{1 - R_{11}}}{\sqrt{1 - r_{11}}},$$

where $\sigma$ and $\Sigma$ are standard deviations of the sets of marks differing in range, and $r_{11}$ and $R_{11}$ are the reliability coefficients of the respective sets of marks. See Kelley, T. L., *Statistical Method*. New York, Macmillan Company, pp. 221-22.

The predictive value of high-school marks received in particular fields of study was determined for the 1923 group. The correlation coefficients run as follows: English, .41; history and civics, .44; mathematics, .46; foreign language, .49; science, .54. The last two show closer relationship to college marks than did the high-school averages (though it would be possible to combine the marks into a weighted average to produce a coefficient higher than any of those given). The parts of the high-school content test correlated with first-year marks as follows: English, literature, etc., .44; mathematics, .49; science, .35; history and social science, .36.

TABLE I

CORRELATIONS OF THE TESTS AND HIGH-SCHOOL AVERAGES WITH FIRST-YEAR MARKS

| | 1921 | | 1922 | | 1923 | | 1924 | |
|---|---|---|---|---|---|---|---|---|
| | Number | r | Number | r | Number | r | Number | r |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| High-school averages | 138 | .46 | 119 | .51 | 102<br>116 | .47<br>.49 (Otis) | 80 | .47 |
| Intelligence tests | 143 | .51 (Alpha) | 130 | .42 (Otis) | 116 | .51 (Terman) | 104 | .55 (A.C.E.) |
| Reading test | 129 | .55 | 131 | .32 | 118 | .56 | 104 | .59 |
| High-school content test | ..... | ..... | ..... | ..... | 101 | .52 | ..... | ..... |

Correlations of tests and high-school averages with instructor's estimates of intelligence in the 1923 group gave the following coefficients: high-school averages, .45; intelligence tests, .41 (Otis) and .44 (Terman); reading test, .48; high-school content tests, .41. The fact that these coefficients are lower than those with scholastic marks may mean merely that the estimates are less accurate and reliable as a criterion, or it may mean that intelligence as estimated is a trait somewhat farther removed from test performance than is the ability reported in marks. Competence in social relations, for example, may enter more prominently into estimated intelligence and thus serve to reduce the correlations with test scores.

Of the four different intelligence tests used—Alpha in 1921, Otis in 1922, Otis and Terman in 1923, and American Council in 1924—no one test appears to be markedly superior or inferior to

the others. In 1923, the correlation between the two intelligence tests was .82. This agreement between somewhat unlike tests indicates a rather high degree of reliability in the intelligence measurements.

The intercorrelations of the tests and high-school averages[2] are almost all low enough to suggest that combinations of scores can be used to give considerably closer predictions than are given by any one measure alone. The theoretically best combinations do, in fact, have correlations with first-year marks of .60 or a little more. This maximum coefficient—determined by multiple correlation methods—is about the same for all three years. The elements in the combination are differently weighted from year to year, however; and it would have been impossible to work out combinations *in advance* which would have produced as close correlations.

In order to see whether the differences in correlation from year to year are due to differences in heterogeneity of the groups, we compared the standard deviations, over the several years, of high-school averages, first-year marks, reading-test scores, and Otis intelligence-test scores. There are no marked or consistent differences. The scores on the reading test and the Otis test received by the 1922 group are a little more homogeneous, but the differences are not great enough to be a major factor in explaining the lower correlations of that year.

### DIFFERENTIATING VALUE OF THE TESTS AND HIGH-SCHOOL AVERAGES

*At the upper levels of ability.*—The reading test and the high-school averages give better differentiation than the intelligence tests in the higher range of ability.[3] Considering all four years, the high-school marks and the reading test scores were of just about equal value in predicting high scholarship, while intelligence-test scores were consistently less useful. The high-school content test in 1923 gave results similar to those of the reading test.

*At the lower levels of ability.*—In the lower ranges of ability, the intelligence tests differentiate, on the whole, a little more successfully than the other methods.[4] In 1921, 1923, and 1924, the

[2] See Table A in the Appendix to this article.
[3] See Tables B and C in the Appendix.
[4] See Tables C, D, and E in the Appendix.

general trend of the data indicates that intelligence tests were better than the reading test, and the reading test was better than the high-school averages, both in predicting low marks and in indicating which students would be probationed or dismissed. In 1924, however, high-school averages served about as well as reading-test scores. High-school content tests again yield results very similar to those of the reading test. The 1922 results are very ambiguous: high-school records are a trifle superior to the reading test, as are the intelligence tests in the main, but some of the evidence is contradictory.

### CORRELATIONS OF THE TESTS AND HIGH-SCHOOL AVERAGES WITH MARKS OF STUDENTS REMAINING THROUGH SUCCESSIVE YEARS

Test scores have distinctly poorer correlation with marks of the second, third, and fourth years than with those for the first year. Correlations with first-year marks are also lower for the students who remain through the year than for the entire entering class. High-school averages, on the contrary, correlate about as well with marks for the later years as with the first-year averages. In all years except 1922, the agreement is actually closer among the students who remain through the first year than it is for the total entering group. These contrasting relationships are evident from the correlation coefficients assembled in Table II. As the group is more and more restricted—by considering only the students who remain through successive years—the test correlations become decidedly smaller (save in 1922) but the high-school coefficients either increase or, in 1922, drop only very slightly.

The decrease in the test coefficients appears to be due in considerable measure to the greater homogeneity of the group after the first term, as a result of scholastic selection. If this increased homogeneity did not obtain, we should expect the several correlations with first-year marks to remain approximately equal in each year.

This can scarcely be accepted as the sole explanation, however. It fails to account for the diminution of the correlations from year to year *within the same group*. It is necessary to assume that certain other factors are operative which change the relative scholastic standing of individuals, such as the encountering of new types of

## TABLE II

### Correlations of Tests and High-School Averages with Marks in Different Years

| | Number[1] | Correlations of Intelligence-Test Scores with: | | | | | Correlations of Reading-Test Scores with: | | | | | Correlations of High-School Averages with: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First-Year Marks | Second-Year Marks | Third-Year Marks | Fourth-Year Marks | Average for 4 Years | First-Year Marks | Second-Year Marks | Third-Year Marks | Fourth-Year Marks | Average for 4 Years | First-Year Marks | Second-Year Marks | Third-Year Marks | Fourth-Year Marks | Average for 4 Years |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
| 1921: | | | | | | | | | | | | | | | | |
| All entering students | 129 | .51 | | | | | .55 | | | | | .46 | | | | |
| Students remaining: | | | | | | | | | | | | | | | | |
| Through first year | 99 | .45 | | | | | .41 | | | | | .63 | | | | |
| Through second year | 49 | .34 | .25 | | | | .36 | .29 | | | | .63 | .40 | | | |
| Through third year | 35 | .26 | .19 | .10 | | | .16 | .08 | .19 | | | .72 | .49 | .60 | | |
| Through fourth year | 30 | .30 | .20 | −.05 | .02 | .20 | .22 | .10 | .13 | .12 | .16 | .70 | .56 | .50 | .40 | .69 |
| 1922: | | | | | | | | | | | | | | | | |
| All entering students | 119 | .42 | | | | | .32 | | | | | .51 | | | | |
| Students remaining: | | | | | | | | | | | | | | | | |
| Through first year | 83 | .39 | | | | | .35 | | | | | .46 | | | | |
| Through second year | 53 | .24 | .16 | | | | .32 | .21 | | | | .44 | .39 | | | |
| Through third year | 40 | .47 | .46 | .27 | | | .42 | .42 | .17 | | | .40 | .46 | .40 | | |
| Through fourth year | 28 | .55 | .53 | .31 | .39 | .43 | .39 | .44 | .09 | .23 | .28 | .41 | .52 | .39 | .46 | .52 |
| 1923:[2] | | | | | | | | | | | | | | | | |
| All entering students | 102 | .49 O<br>.51 T | | | | | .56 | | | | | .47 | | | | |
| Students remaining: | | | | | | | | | | | | | | | | |
| Through first year | 71 | .32<br>.41 | | | | | .33 | | | | | .55 | | | | |
| Through second year | 53 | .16<br>.37 | .20<br>.14 | | | | .43 | .27 | | | | .52 | .54 | | | |
| Through third year | 36 | .18<br>.29 | .16<br>.04 | .01<br>.11 | | | .41 | .15 | .12 | | | .51 | .53 | .55 | | |
| 1924: | | | | | | | | | | | | | | | | |
| All entering students | 80 | .55 | | | | | .54 | | | | | .47 | | | | |
| Students remaining: | | | | | | | | | | | | | | | | |
| Through first year | 65 | .45 | | | | | .47 | | | | | .56 | | | | |
| Through second year | 36 | .43 | .32 | | | | .45 | .28 | | | | .52 | .54 | | | |

[1] The number of cases varies somewhat for the coefficients in a given row. The minimum number is given in each instance. The maximum is greater by anywhere from 2 or 3 to 25 cases.

[2] The correlation figures for the high-school content test in 1923 are, with first-year marks: all entering students, .52; students remaining through the first year, .46; students remaining through the second year, .46; students remaining through the third year, .38. With second-year marks the correlations are: students remaining through the second year, .13; students remaining through the third year, −.05. With third-year marks the correlation for students remaining through that year is, .07.



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studies, variations in the standards of marking, adoption of different attitudes and degrees of effort by students, and the development of new interests and new abilities and disabilities.

Examination of the individual scholastic records supports the conclusion that individuals change their relative scholastic standing and that these shifts are, on the whole, ones that reduce the correlation with test scores. Some importance attaches to the question whether these changes of relative standing are due to actual changes in ability to do the required academic work, or whether they are brought about by other causes. If the changes are due to the increasing unsoundness of marks as true indicators of ability, the lower correlations may not reflect any shortcoming of tests as measures of scholastic ability.

There is no apparent reason why marks should be considered less reliable in the later years than earlier, as indicators of qualitative differences in academic performance. Accordingly, it seems probable that actual changes in the relative excellence of students' work are responsible for the decreased correlations of test scores and marks. This is equivalent to the conclusion that tests become increasingly unsatisfactory as a basis for predicting scholarship beyond the first year. If, then, our ambition is to prognosticate as to the long-run achievement of students, the present evidence suggests some serious doubts about the adequacy of our ordinary selective tests.

To be sure, it may be maintained that the aim of the tests is not to predict college achievement, but to reveal intellectual potentialities. But, in that event, it is important that the distinction be made and that we strive to evaluate tests by reference to criteria other than simple records of academic performance.

The foregoing considerations regarding tests become more significant in view of the contrasting relations found for high-school averages. The increase in the correlations from year to year, based on high-school marks, is no less in need of interpretation than the corresponding decrease of the test correlations.

A partial explanation is this: a number of students who succeeded fairly well in high school fall down in their first-year college work and are eliminated during the year. When they are included in the correlation tables, they reduce the coefficients; when they

are omitted, the coefficients tend to rise. That there are more individuals of this class according to high-school grouping than by test grouping is brought out by a detailed comparison of college grades with test scores and with high-school averages. For example, in the lowest quarter of the class by first-year marks in 1921, 62 percent (21 of 34) were in the upper three-fourths by high-school averages, as contrasted with 40 percent (14 of 35) in the upper three-fourths by intelligence test scores and 41 percent (13 of 32) by reading-test scores. Similarly, the percent of students below zero grade-points was as great among the upper three-fourths by high-school averages as in the lowest one-fourth, whereas the percents for the test showed very few of these failures in the upper three-fourths (2 percent and 6 percent in the upper three-fourths as compared with 35 percent and 29 percent in the lowest one-fourth). The evidence regarding dismissal and probation is in the same direction. The results in 1923 and 1924 are similar though a little less marked. In 1922, when the high-school coefficients did not increase, the conditions which have just been pointed to as true of 1921 and 1923, were not present. There were not, that is to say, a large number of students with fair high-school marks and very low first-year college marks.

The foregoing interpretation accounts at best only for the increase (or lack of significant decline) in correlations as the total entering class becomes more restricted. It leaves untouched the more interesting question of why the correlations with second-, third-, and fourth-year college marks fail to decrease as do the coefficients for tests. The most plausible explanation that suggests itself is that the scholastic achievement of students in their four years of high school represents the abilities, interests, and traits which determine the long-run performance in college considerably better than do our ordinary psychological tests. It may well be that, in the first-year, tests serve as well as high-school marks, or better, because almost all students are rather strongly motivated during those early months, while later achievement depends more on enduring interests, work habits, and character traits of the sort reflected in high-school marks but not diagnosed by mental tests.[5]

[5] An interesting bit of evidence which points in the direction suggested comes from our correlations between grades and scores on the Downey Will-

All this comparison of test and high-school correlations raises acutely the issue of what our criterion should be for judging the value of the predictive device used. If we are primarily interested in first-year scholarship, especially in eliminating students likely to do poor work as Freshmen, then the present results indicate that tests are of considerable worth and are better than high-school averages. If we are chiefly interested in scholarship of later years in college, tests are of slight value and are distinctly inferior to high-school marks, which latter are reasonably useful. If we are, perchance, concerned with predicting which students will be most successful doctors, bankers, and salesmen, or most worthy citizens, or most happy men, our predictive devices may be highly valuable or they may be worse than useless. There is no evidence based on these criteria. If we seek to determine scholastic *aptitude* or *potentiality*, as distinguished from actual performance, we must be clear that this is our aim and must accordingly attempt to evaluate our selective methods by reference to something more than their degree of agreement with performance as revealed in grades.

If test scores fail to correlate closely with later college achievement it may mean not that the tests are to be discarded but that the machinery for developing and utilizing the potential abilities of students needs overhauling. The writer feels that we have been too complacent in our acceptance of college grades as the final word in judging tests and other devices. Have we not reached a point where the development of selective tools for college admission demands better definition of objectives in selection and more careful re-examination of the criteria by which to judge the selective practices? A given selection procedure may be of vastly different value depending upon whether we especially prize brilliance, enduring intellectual interests, effective habits of work, winning personality, or competence in athletics.

After all, selection methods are not unique in the fact that they must be evaluated in terms of objectives. Perhaps there are

Temperament Test. With first-year marks the scores for "motor inhibition," "interest in detail," and "coordination of impulses" are .19, .20, and .15 respectively. While these are all of doubtful significance, they hint at a relationship between accuracy and industry and first-year achievement. Beyond the first year no sign of this relationship appears. The correlations of the three parts of the test with second-year marks are .07, .00, and —.06 respectively; with third-year marks, they are —.02, .02, and .01.

other academic activities which would profit if they, too, could be planned and judged on the basis of clearer formulations of the aims of a college education.


## SUMMARY

Correlations have been reported to show the agreement of high-school averages and scores on several tests with college marks over a period of several years. The correlations with first-year scholarship are, in general, closest for a reading comprehension test; intelligence tests come next; high-school averages are last. The coefficients were almost all between .45 and .60. Of the four intelligence tests used, no one appears markedly superior or inferior to the others. In the higher ranges of ability, the reading test and high-school averages give better differentiation than the intelligence tests (using first-year marks as the criterion). Toward the lower extreme, the intelligence tests differentiate a little more successfully than the other methods.

A striking contrast appears between the tests and the high-school averages when correlations with college marks beyond the first year are considered. As a whole, the test correlations decrease rather sharply while the coefficients for high-school marks increase or remain constant. This is true also of correlations for students remaining through the first year as compared with correlations for the entire entering class.

Some attempts are made to interpret these relationships and certain implications are suggested regarding the evaluation of selective devices in colleges. In particular the need is stressed for clearer statements of the aims of selection procedures and for the setting up of criteria based upon a recognition of these objectives.

## APPENDIX

### TABLE A

INTERCORRELATIONS OF THE TESTS AND HIGH-SCHOOL AVERAGES

| (1) | 1921 (2) | 1922 (3) | 1923 (4) | 1924 (5) |
|---|---|---|---|---|
| High-school averages and intelligence tests | .28 | .30 | .39 (Otis)<br>.42 (Terman) | .25 |
| High-school averages and reading tests | .24 | .15 | .42 | .26 |
| High-school averages and high-school content tests | ..... | ..... | .30 | ..... |
| Intelligence tests and reading tests | .56 | .51 | .62 (Otis)<br>.67 (Terman) | .64 |
| Intelligence tests and high-school content tests | ..... | ..... | .54 (Otis)<br>.61 (Terman) | ..... |
| Reading tests and high-school content tests | ..... | ..... | .45 | ..... |

### TABLE B

DISTRIBUTION OF FIRST-YEAR MARKS OF STUDENTS IN HIGHEST AND LOWEST QUARTERS OF THE CLASS BY TESTS AND HIGH-SCHOOL AVERAGES

| (1) | PERCENT IN EACH QUARTER OF CLASS BY AVERAGE FIRST-YEAR MARK: Lowest Quarter (2) | Third Quarter (3) | Second Quarter (4) | Highest Quarter (5) |
|---|---|---|---|---|
| | Highest Quarter | | | |
| 1921: | | | | |
| Highest quarter by high-school average | 6 | 12 | 18 | 65 |
| Highest quarter by intelligence test | 11 | 29 | 18 | 42 |
| Highest quarter by reading test | 6 | 14 | 31 | 49 |
| 1922: | | | | |
| Highest quarter by high-school average | ..... | 27 | 35 | 38 |
| Highest quarter by intelligence test | 12 | 29 | 24 | 35 |
| Highest quarter by reading test | 9 | 21 | 32 | 38 |
| 1923: | | | | |
| Highest quarter by high-school average | ..... | 8 | 46 | 46 |
| Highest quarter by intelligence test (Otis) | 10 | 21 | 31 | 38 |
| Highest quarter by intelligence test (Terman) | 7 | 14 | 39 | 39 |
| Highest quarter by reading test | ..... | 17 | 24 | 59 |
| Highest quarter by high-school content test | ..... | 24 | 24 | 52 |
| 1924: | | | | |
| Highest quarter by high-school average | 10 | 10 | 29 | 52 |
| Highest quarter by intelligence test | 11 | 19 | 11 | 59 |
| Highest quarter by reading test | 4 | 16 | 20 | 60 |

TABLE B (*Continued*)

| | Percent in Each Quarter of Class by Average First-Year Mark | | | |
|---|---|---|---|---|
| | Lowest Quarter | Third Quarter | Second Quarter | Highest Quarter |
| (1) | (2) | (3) | (4) | (5) |
| | Lowest Quarter | | | |
| 1921: | | | | |
| Lowest quarter by high-school average | 37 | 37 | 17 | 9 |
| Lowest quarter by intelligence test | 62 | 12 | 20 | 6 |
| Lowest quarter by reading test | 61 | 16 | 19 | 3 |
| 1922: | | | | |
| Lowest quarter by high-school average | 47 | 31 | 16 | 6 |
| Lowest quarter by intelligence test | 45 | 23 | 23 | 10 |
| Lowest quarter by reading test | 43 | 30 | 10 | 17 |
| 1923: | | | | |
| Lowest quarter by high-school average | 31 | 38 | 15 | 15 |
| Lowest quarter by intelligence test (Otis) | 71 | 18 | 11 | ..... |
| Lowest quarter by intelligence test (Terman) | 60 | 20 | 17 | 3 |
| Lowest quarter by reading test | 52 | 16 | 26 | 6 |
| Lowest quarter by high-school content test | 50 | 23 | 19 | 8 |
| 1924: | | | | |
| Lowest quarter by high-school average | 50 | 32 | 14 | 5 |
| Lowest quarter by intelligence test | 52 | 33 | 15 | ..... |
| Lowest quarter by reading test | 43 | 30 | 26 | ..... |

TABLE C

Differentiation of Students High in First-Year Average Marks, by Means of Tests and High-School Averages

| | Percent with First-Year Average of Four Grade-Points or More | | Percent with First-Year Average of Three Grade-Points or More | |
|---|---|---|---|---|
| | Among Highest Quarter[a] | Among Lower Three-quarters[a] | Among Highest Quarter[a] | Among Lower Three-quarters[a] |
| (1) | (2) | (3) | (4) | (5) |
| 1921: | | | | |
| High-school averages | 23 | 2 | 71 | 13 |
| Intelligence test | 16 | 4 | 42 | 20 |
| Reading tests | 14 | 4 | 49 | 20 |
| 1922: | | | | |
| High-school averages | 23 | 4 | 50 | 27 |
| Intelligence test | 18 | 4 | 38 | 28 |
| Reading test | 21 | 3 | 44 | 27 |

TABLE C (*Continued*)

| | Percent with First-Year Average of Four Grade-Points or More | | Percent with First-Year Average of Three Grade-Points or More | |
|---|---|---|---|---|
| | Among Highest Quarters[a] | Among Lower Three-quarters[a] | Among Highest Quarters[a] | Among Lower Three-quarters[a] |
| (1) | (2) | (3) | (4) | (5) |
| 1923: | | | | |
| High-school averages | 25 | 4 | 46 | 17 |
| Intelligence test (Otis) | 17 | 5 | 38 | 18 |
| Intelligence test (Terman) | 11 | 7 | 39 | 18 |
| Reading test | 17 | 4 | 59 | 11 |
| High-school content test | 24 | 4 | 52 | 14 |
| 1924: | | | | |
| High-school averages | 24 | 7 | 62 | 22 |
| Intelligence test | 33 | 4 | 59 | 22 |
| Reading test | 36 | 4 | 60 | 23 |

[a]As classified by the method listed.

TABLE D

Differentiation of Students Low in First-Year Average Marks, by Means of Tests and High-School Averages

| | Percent with First-Year Average of Less Than 0 Grade-Points | | Percent with First-Year Average of Less Than 1 Grade-Points | |
|---|---|---|---|---|
| | Among Lowest Quarter[a] | Among Upper Three-fourths[a] | Among Lowest Quarter[a] | Among Upper Three-fourths[a] |
| (1) | (2) | (3) | (4) | (5) |
| 1921: | | | | |
| High-school averages | 11 | 12 | 29 | 17 |
| Intelligence test | 35 | 2 | 59 | 8 |
| Reading test | 29 | 6 | 48 | 12 |
| 1922: | | | | |
| High-school averages | 25 | 5 | 31 | 11 |
| Intelligence test | 26 | 3 | 35 | 9 |
| Reading test | 20 | 7 | 30 | 14 |
| 1923: | | | | |
| High-school averages | 15 | 11 | 27 | 18 |
| Intelligence test (Otis) | 36 | 2 | 57 | 6 |
| Intelligence test (Terman) | 27 | 2 | 40 | 8 |
| Reading test | 29 | 3 | 39 | 10 |
| High-school content test | 27 | 5 | 38 | 8 |
| 1924: | | | | |
| High-school averages | 14 | 5 | 32 | 14 |
| Intelligence test | 19 | 1 | 44 | 4 |
| Reading test | 17 | 2 | 35 | 9 |

[a]As classified by methods listed.

## TABLE E

PREDICTIONS OF DISMISSAL AND PROBATION BY MEANS OF TESTS AND HIGH-SCHOOL AVERAGES

| | PERCENT DISMISSED DURING THE FIRST YEAR | | PERCENT DISMISSED OR ON PROBATION DURING FIRST YEAR | |
|---|---|---|---|---|
| | Among Lowest Quarter* | Among Upper Three-quarters* | Among Lowest Quarter* | Among Upper Three-quarters* |
| (1) | (2) | (3) | (4) | (5) |
| 1921: | | | | |
| High-school averages | 21 | 14 | 38 | 22 |
| Intelligence test | 47 | 5 | 62 | 14 |
| Reading test | 32 | 11 | 52 | 16 |
| 1922: | | | | |
| High-school averages | 31 | 11 | 63 | 20 |
| Intelligence test | 47 | 8 | 47 | 25 |
| Reading test | 27 | 12 | 50 | 23 |
| 1923: | | | | |
| High-school averages | 31 | 11 | 77 | 43 |
| Intelligence test (Otis) | 52 | 6 | 72 | 37 |
| Intelligence test (Terman) | 39 | 6 | 74 | 35 |
| Reading test | 32 | 11 | 68 | 41 |
| High-school content test | 35 | 8 | 73 | 40 |
| 1924: | | | | |
| High-school averages | 45 | 9 | 55 | 20 |
| Intelligence test | 37 | 6 | 59 | 8 |
| Reading test | 35 | 9 | 44 | 15 |

*As classified by methods listed.

# A SILENT READING TEST IN SPANISH

M. EUSTACE BROOM
*Francis W. Parker School, San Diego, California*

THIS article describes the construction and validation of a test which was designed to measure the ability of high-school students to read and to comprehend the meaning of printed Spanish language. This test was devised by Sra. María S. Contreras and Walter Kaulfers in collaboration with the writer.

## DERIVATION AND VALIDATION

The test is designed to measure achievement in comprehension of the printed Spanish language at successive stages under varying conditions and with varying methods of teaching. It is not based upon any single textbook in Spanish but upon a background vocabulary which was prepared by the writers to serve as a suggested basis for unstandardized tests in Spanish. This vocabulary included only words of common frequency in a number of lists of Spanish words which were prepared by their several authors after they had examined a large number of elementary textbooks in Spanish, tabulating in each case the words common to all of the Spanish grammars and Spanish readers which they had examined. In so far as was possible, the exercises of the standardized test were arranged to include only words found in this word list. In this way, the authors sought to limit the vocabulary of the test to words of common occurrence in high-school courses in Spanish. Although there may be more desirable criteria for the validation of test materials than the one used in this study, it is nevertheless true that teaching practice in any subject follows very closely the organization and materials of the available textbooks. This very practical consideration is held to be a sufficient justification of a test which embodies the materials of common frequency in the books which must be used by students of high-school Spanish.

The test was prepared in two forms, now designated as Form A and Form B. These forms originally included many more exercises than were later submitted as a final preliminary form of the test to high-school students. This was considered necessary, since it was

desirable to have exercises of various degrees of difficulty, ranging by graduated steps from those which were quite easy to those which were very difficult. Furthermore, it permitted elimination of some of the exercises of approximately the same difficulty which were always found "piling up" near the exercise of median difficulty. The preliminary grading of this material was accomplished by submitting the preliminary forms of the test to a number of competent teachers who arranged the exercises as nearly as they could in uniformly progressive steps of difficulty. This arrangement was later checked by a small group of Spanish scholars, including principally professional men and writers of Mexico. The resulting two forms were submitted as blackboard exercises to approximately two hundred junior high-school pupils in the first, second, or third semester of Spanish. On the basis of the results of this application of the test, the exercises were scaled in terms of their difficulty to high-school pupils, and certain ones were eliminated. The test exercises were placed in their relative positions on the linear scale on the basis of difficulty of solving. The probable error was chosen as the unit of value. The arbitrary zero point, or point of departure, was taken at negative $7PE$.[1]

The usability of the test with reference to clearness of the directions, convenience of administration, adequacy of time allowance, and objectivity of scoring was determined. The reorganized test was mimeographed and tried out again with a somewhat larger group of students in the same courses in Spanish. The test exercises were again rearranged into two forms of equal difficulty by the probable-error method.

Following these preliminary trials of the test and its reorganization into two tentatively duplicate forms of twenty paragraphs each, the authors published a preliminary edition of the test. Both forms of this edition were administered just prior to the close of the first semester of the school year of 1926-27 to about four thousand pupils in the first eight semester courses in Spanish in Des Moines, Iowa; Copton, Los Angeles, San Diego, and San Francisco, California; Chicago, Illinois; and Kenosha, Wisconsin. A portion of these tests, given in one high school each in Los Angeles and in

[1] The method used has been described by Walter S. Monroe in *An Introduction to the Theory of Educational Measurements*. Boston, Houghton Mifflin Company, 1923. Chapter IV.

San Diego, were returned too late to be considered in this report. The final trial of the test was held to check the difficulty of the test exercises as previously determined, the validity and reliability of the test, and the tentative norms which had been established during the earlier experimentation. Instructions were sent to the examiners in every school to make sure that the methods of giving the test and the directions for its use were followed with strict uniformity. The tests in every case were given to class groups, not to pupils especially selected by the teachers. The time limit was rigorously observed. The first page of Form A of the test is reproduced here.

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### A SILENT READING TEST IN SPANISH

Do not open this paper, or turn it over, until you are told to do so. Fill out all of the blanks, giving all information as accurately as you can. Write plainly.

Name..... Sex..... Age.....

Draw a line under the number of semesters of Spanish you have studied

1 2 3 4 5 6 7 8

School..... City..... State.....

Date of examination..... Examiner.....

Day Month Year

### DIRECTIONS

On the following pages are a number of exercises to test your ability to read Spanish silently. Each exercise consists of a short paragraph with a question and a series of five words at the end. The correct answer to the question is in each case one of the words in the series. Look at the exercise below.

—¿Cómo estás hoy, Juan?
—Muy bien, gracias, Antonio; y tú?
—Bien, gracias. ¿Cómo está tu señora madre?
—No está bien hoy. Tiene un resfriado grave.
¿Cómo está la madre de Antonio?

bien ocupada triste <u>mal</u> alegre

Here the Spanish word <u>mal</u> answers the question correctly, so it is underlined.

You are to read each exercise on the following pages as accurately and as rapidly as you can. Then you are to answer the question by underlining the correct word in the series at the end. If you underline a word by mistake and wish to correct the error, cross out entirely the word wrongly underlined and underline the word you consider correct.

When you have read these directions, wait for the teacher's signal to begin, then start with the first exercise and take each one in order until you have completed the test.

Either form of the test may be given easily in twenty-two minutes. This is an ample allowance of time for all but the slowest pupils in the first semester of Spanish. Even with these pupils, increasing the time of testing has not been found to increase their scores significantly, since the exercises near the end of the forms are much too difficult for first-semester students in Spanish. If a longer test is desired, both forms of the test may be used and the scores averaged, thus giving a slightly more reliable measure of the achievement of different pupils. The brevity of the test effects an economy of class time which is an asset rather than a liability to the teacher.

The directions for the final form of the test are given later. It is exactly the same for both forms of the test. With the exception of two blanks to be filled out by the student taking the test, which were included in the preliminary edition but were eliminated from the final form of the test, and the shifting of two sentences to a position above the information blanks from a position immediately below them, the page of final directions is identical with that of the earlier edition.

By way of illustrating the character and arrangement of the materials of the test, two of the exercises are included in this report. The first is relatively easy, but the second is much more difficult.

—Apenas se puede leer lo que Juan escribe. Parece que no ha aprendido a escribir bien; porque forma las letras muy incorrectamente y con mucha dificultad.

¿Cómo escribe Juan?

bien rápidamente mal correctamente fácilmente

—Después de partir de Los Angeles, pasamos por varios sotos de albericoques, olivos, perales, limoneros, naranjos, e higueras. Tan grandes y densas eran las arboledas que parecían bosques.

¿Por dónde pasábamos?

huertas jardines viñas campos bosques

There has been some criticism of the word usage in the second of these paragraphs. It is contended that "huertas" is not correctly interpreted to mean "orchards." The usage has two justifications. This paragraph is a direct outcome of a visit of the third author to "las huertas de Valencia" in Southern Spain. It is, furthermore, the usage of the Pequeño Larouse *Ilustrado*.[2]

[2] Larouse, Pequeño. *Ilustrado. Nuevo Diccionario Elciclopédico.* Publicado Bajo La Dirreccion de Claude Augé. Adaptacion Española de Miguel de Toro y Gisbert. Paris, Liberia Larouse, 13-17, Rue Montparnasse, 1926. 1528 pp.

The authors made a final check of the difficulty of the test items and their correct placement in order of difficulty within the two forms of the test on the basis of the returns from the administrations of the third edition. While the final values of the test exercises varied slightly in some cases from those determined following the preliminary trials of the material, the changes were relatively small and few in number. Only minor rearrangement in the order

TABLE I

PERCENTILE DISTRIBUTION OF DIFFICULTY VALUES IN THE TWO FORMS OF THE TEST

| | 10th Percentile | First Quartile | Median | Third Quartile | 90th Percentile | Total Points |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Form A | 4.82 | 5.34 | 6.70 | 7.04 | 7.82 | 126.51 |
| Form B | 4.64 | 5.70 | 6.66 | 7.28 | 7.64 | 127.43 |

TABLE II

VALIDITY COEFFICIENTS OF THE TEST

| School | Grades | Number of Students | r (Pearson) | Probable Error | Index of Reliability |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1 | VIII, IX | 50 | .679 | .051 | .824 |
| 2 | X | 58 | .711 | .044 | .843 |
| 3 | IX, XI, XII | 122 | .584 | .040 | .764 |

of a few of the test paragraphs in each form was necessary. The percentile distribution of the difficulty values for the exercises in the two final forms is shown in Table I. When the total points on the two forms are compared, Form B is less than one percent more difficult than Form A.

Very little data as to the validity of the test are available. Coefficients of correlation between average school marks in Spanish (two semesters) and test scores for one form of the test are presented in Table II. The relatively low coefficients of correlation listed in this table may be explained in part by the low reliability of end-term marks or grades.

### TENTATIVE NORMS

When it was found that the tests as they were given in seven different school systems were already equivalent within one per-cent of mutual agreement, it was possible to determine tentative norms at once. It has seemed inadvisable to burden this report with the data for these different school systems, so five percentile

TABLE III

TENTATIVE NORMS FOR THE SILENT READING IN SPANISH

| Semester of Study | Sex | Number of Cases | 10th Percentile | First Quartile | Median | Third Quartile | 90th Percentile |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| First | Boys | 868 | 5.39 | 7.14 | 9.46 | 12.02 | 14.37 |
| | Girls | 1042 | 4.80 | 6.93 | 9.21 | 12.28 | 14.19 |
| Second | Boys | 520 | 8.78 | 10.39 | 12.71 | 13.89 | 16.01 |
| | Girls | 568 | 8.18 | 10.00 | 13.50 | 13.98 | 16.31 |
| Third | Boys | 738 | 10.53 | 12.69 | 14.37 | 17.37 | 18.68 |
| | Girls | 968 | 10.71 | 12.90 | 14.96 | 17.01 | 18.77 |
| Fourth | Boys | 448 | 12.99 | 13.79 | 16.30 | 18.02 | 19.63 |
| | Girls | 468 | 12.16 | 13.52 | 15.64 | 17.44 | 18.72 |
| Fifth | Boys | 62 | 15.00 | 16.00 | 16.50 | 18.65 | 19.34 |
| | Girls | 126 | 13.25 | 15.38 | 16.80 | 18.42 | 18.98 |
| Sixth | Boys | 12 | 16.10 | 16.25 | 18.50 | 18.78 | 19.55 |
| | Girls | 32 | 12.60 | 15.38 | 16.12 | 18.33 | 18.97 |
| Seventh | Boys | | | | | | |
| | Girls | 24 | 15.30 | 16.13 | 16.95 | 17.31 | 18.78 |
| First College | Men | 20 | 6.00 | 9.00 | 11.13 | 14.25 | 17.50 |
| | Women | 38 | 7.12 | 10.10 | 14.40 | 17.46 | 17.92 |
| Second College | Men | 16 | 10.50 | 12.50 | 14.50 | 16.20 | 18.20 |
| | Women | 20 | 5.00 | 12.00 | 16.67 | 17.88 | 19.50 |

measures only for each semester-of-study and sex group are given. Percentile norms are not quite as accurate in general as T-scores or other similar measures based upon the standard deviation. They are more meaningful, perhaps, to the average teacher. The median and the quartiles are only special names for the 50th, 25th, and 75th percentiles.

The distribution of the tests in school systems along the Pacific Coast and in Central Western States, both urban and rural, and

the giving of the tests both in junior and senior high schools of different sizes and characteristics in the different school systems was part of a definite plan to obtain valid and universal norms. It was found impossible to determine grade and age norms. Numerous ninth-grade classes were found in which pupils were doing third- or fourth-semester work in Spanish, while in one school there were eleventh-grade students in first-semester Spanish. Furthermore, the wide variations in ages within groups in different groups might find a boy of fourteen doing fourth-semester work

TABLE IV

RELIABILITY COEFFICIENTS OF THE TEST

| City and School | State | Number of Students | r (Pearson) | Probable Error | Index of Reliability |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Compton, Union High School | California | 163 | .790 | .020 | .889 |
| Los Angeles, twelve junior and senior high schools | California | 1,408 | .778 | .007 | .882 |
| San Diego, five junior and senior high schools | California | 638 | .818 | .009 | .904 |
| San Francisco, Horace Mann Junior High School | California | 64 | .686 | .045 | .828 |
| Chicago, Austin High School | Illinois | 412 | .817 | .011 | .904 |
| Des Moines, East High School | Iowa | 72 | .717 | .039 | .847 |
| Kenosha, Central High School | Wisconsin | 181 | .861 | .013 | .930 |

while a boy of sixteen might be doing first-semester work. The final tentative norms include end-of-semester percentile measures for the different semester-of-study and sex groups. The data are given in Table III.

These norms are relatively stable for the groups for semesters one to four of the high school. The addition of over one hundred new cases each from Des Moines and San Francisco did not materially alter the previously determined norms. The norms for semesters five to seven of the high school and for the first two semesters of the college are not very reliable, having been based on too few cases.

The reliability coefficients of the test have been computed for the classes in seven school systems. The scores from Form A were correlated with scores from Form B. These coefficients of reliability, given in Table IV, are sufficiently high to indicate that the test is a reliable measuring instrument.

### VALUES OF THE TEST TO TEACHERS

The test should be of use to teachers of high-school courses in Spanish in several ways. It should aid in classifying pupils into sections for the purpose of differentiating their rates of progress or for enriching the curriculum for the more able pupils; and it should assist in the determination of students who have earned promotions or failures. The test should also serve in the assignment of school marks, by furnishing a more objective and reliable basis of judgment than the teachers' unsupported estimates of achievement. In setting up immediate educational objectives such as checking the course of study to determine the amount and rate of instruction with given groups of students, the test should serve an immediate end; and provide an unbiased means of comparing the results secured by a teacher in different sections of her courses or by different teachers of similar courses in the same school or in different schools.

# THE PREDICTIVE VALUE OF GROUP INTELLIGENCE TESTS

W. S. Guiler
*Miami University*

This article reports the results of a study which was made to discover how well three widely used group tests of intelligence can predict achievement in learning college subjects. The study is based on two sets of data. The first comprises the subject-marks of eighty Freshmen who were enrolled at Miami University during the college year of 1925-26. The second consists of the scores which resulted from giving three group tests of intelligence to the same students during the early part of the college year. The tests used are given in the following paragraph.

The Ohio College Association Test, devised by H. A. Toops, of Ohio State University, will be referred to as the O.C.A. test. It appears in a number of forms, each of which consists of five subtests—arithmetic, word meaning, analogy, number series, and reading. Forms 7 and 8 were used in this study. The examination occupies ninety-one minutes. The Otis Self-Administering Test of Mental Ability and the Terman Group Test of Mental Ability, the other tests used, are so well known as to need no description. Both tests have two forms, A and B, and both were used in the study. The time limit of the Otis test is thirty minutes, and of the Terman test, twenty-seven minutes.

## DATA AND METHOD

Table I contains a limited sampling of the original data on which the study is based. Achievements of the six students included in the table are shown in Columns 2 and 3. The ratings are based on the marks earned by the students in their various courses during 1925-26. In obtaining a student rating, points were allotted as follows: A-130, B-115, C-100, D-85, E-70, F-0. Reference to Table I will illustrate how a rating was computed. Student 1 earned twenty hours of A and ten hours of B during the year. These marks entitle the student to 3,750 points which, divided by 30—the number of student-hours—gives a rating of 125. A rating computed by means of this scheme is called a Missouri rating since

it was first devised and used at the University of Missouri. Columns 4 to 9 give the scores yielded by the O.C.A., the Otis, and the Terman tests for the six students. Each student was given a quarter-placement rank, as determined by the relation which his Missouri rating and his three intelligence scores bore to the ratings and scores of the other seventy-nine students. Table I is then read as

TABLE I

MISSOURI RATINGS AND INTELLIGENCE SCORES OF SIX COLLEGE FRESHMEN

| STUDENT | MISSOURI RATING | | O.C.A. TEST | | OTIS TEST | | TERMAN TEST | |
|---|---|---|---|---|---|---|---|---|
| | Rating | Quarter Placement | Score | Quarter Placement | Score | Quarter Placement | Score | Quarter Placement |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 1..... | 125.0 | 1 | 250 | 1 | 69 | 1 | 194 | 1 |
| 16..... | 113.5 | 1 | 100 | 4 | 43 | 4 | 146 | 4 |
| 32..... | 108.9 | 2 | 145 | 3 | 41 | 4 | 149 | 4 |
| 48..... | 102.0 | 3 | 188 | 2 | 60 | 1 | 177 | 2 |
| 64..... | 96.0 | 4 | 178 | 2 | 37 | 4 | 149 | 4 |
| 80..... | 62.1 | 4 | 94 | 4 | 32 | 4 | 128 | 4 |

TABLE II

CORRELATION OF INTELLIGENCE SCORES WITH MISSOURI RATINGS

| Semester | Correlation with Terman Test | Correlation with Otis Test | Correlation with O.C.A. Test |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| First..... | .49 | .48 | .45 |
| Second..... | .48 | .40 | .44 |
| Both..... | .52 | .49 | .47 |

follows: Student 1 attained a Missouri rating of 125 and first-quarter rank, an O.C.A. score of 250 and first-quarter rank, an Otis score of 69 and first-quarter rank, and a Terman score of 194 and first-quarter rank.

Two procedures were used to determine the predictive value of the three intelligence tests. The first, the method of correlation, was used to discover the extent to which the intelligence scores are

accompanied by corresponding attainments in the school subjects. The second procedure, involving the use of the method of quarter-rank displacement, attempts to measure the amount of displacement which takes place when the students are ranked according to educational achievement, as indicated by their Missouri ratings, and according to the magnitude of their intelligence scores. Two types of results were obtained. These are expressed in terms of correlations and rank displacements.

## RESULTS

*Correlations.*—The following figures give the extent to which the tests correlate in measuring intelligence: Terman and O.C.A., .75; Terman and Otis, .74; Otis and O.C.A., .61. These figures show about the same degree of high relationship between the scores yielded by the Terman and O.C.A. tests as between those derived from the Terman and Otis tests. A fair degree of correlation is found between the scores yielded by the Otis and O.C.A. tests.

The primary purpose of this study was to discover how successfully certain group tests of intelligence can predict college achievement. Table II presents the evidence on the predictive potency of the test in terms of inner correlations. These correlations would seem to indicate that the three intelligence tests have approximately equal value in predicting ability to do school work. The Terman test is slightly superior to the Otis test, and the latter has a slight advantage over the O.C.A. test. The fact that either the Terman or the Otis test is much easier to give and score and requires much less time than the O.C.A. test makes either of the former a strong favorite over the latter.

The criterion set up in this study for evaluating the predictive potency of group tests of intelligence is school marks. To obtain a check on the reliability of the criterion, the relationship between marks received in the first and second semesters was studied. The resulting correlation was .69.

One of the major problems in the measurement of intelligence involves the selection of test materials. The importance of the problem becomes apparent when one considers how widely the different group tests disagree in rating children. In measuring the intelligence of sixty-three upper-grade children, the writer found

a median disparity of 11 *IQ*-steps between the National Intelligence Tests and the Illinois Examination; the median disparity between the Illinois Examination and the Pintner Non-Language Test, and between the National and Pintner tests was 15 and 21 *IQ*-steps respectively.[1] The fact that the three tests include different test elements probably accounts, in large measure, for the marked variance in intelligence ratings.

To obtain some measure of the comparative efficacy with which different kinds of test material can foretell successful achievement, correlations were computed between the scores made by the eighty Freshmen on the separate Terman and O.C.A. tests and their corresponding subject-marks. The following table illustrates the correlation of the Terman tests with the Missouri ratings:

| Test | Correlation |
|---|---|
| 1 (Information) | .34 |
| 2 (Best answer) | .17 |
| 3 (Word meaning) | .26 |
| 4 (Logical selection) | .30 |
| 5 (Arithmetic) | .42 |
| 6 (Sentence meaning) | .35 |
| 7 (Analogies) | .36 |
| 8 (Mixed sentences) | .19 |
| 9 (Classification) | .26 |
| 10 (Number series) | .39 |

This table shows that Test 5, arithmetical problem-solving material, predicts school achievement better than any of the tests included in the Terman Group Test; number-series material follows as a close second. Then follow three types having about equal predictive merit. These are analogies, sentence meaning, and information. The types having the least predictive value are, in order of mention, best answer, mixed sentences, word meaning, classification, and logical selection.

The degree of correlation between the separate O.C.A. tests and the Missouri ratings is shown as follows:

| Test | Correlation |
|---|---|
| 1 (Arithmetic) | .36 |
| 2 (Word meaning) | .41 |
| 3 (Analogies) | .43 |
| 4 (Number series) | .33 |
| 5 (Reading) | .40 |

[1] Guiler, W. S. "How Different Mental Tests Agree in Rating Children," *Elementary School Journal*, 22:734-44, June, 1922.

The best correlation is seen to exist between analogies and scholarship, with word meaning and reading close seconds. The poorest correlation is found between number-series material and school marks. Arithmetical problem-solving material shows next to the poorest correlation with scholarship.

The Terman and O.C.A. tests include four of the same test divisions. These are word meaning, arithmetic, analogies, and number series. Table III shows how well these common types of test material agree in predicting successful achievement. According to Table III, the word-meaning material in the Terman test correlates .26 with scholarship, while the same type of material in the O.C.A. test correlates .41. The table shows the greatest disparity

TABLE III

CORRELATION OF MATERIAL COMMON TO THE TERMAN AND O.C.A. TESTS WITH SCHOLARSHIP

| Type of Material | Terman | O. C. A. |
|---|---|---|
| (1) | (2) | (3) |
| Word meaning | .26 | .41 |
| Arithmetic | .42 | .36 |
| Analogies | .36 | .43 |
| Number series | .39 | .33 |

in the predictive potency of the word-meaning material. The arithmetic, analogies, and number-series materials in one test seem to correlate with scholarship about as well as do the same types of material in the other test.

The question often arises as to the value of a general intelligence test in predicting successful achievement in particular subjects. In order to throw some light on this point, correlations were computed between the various divisions of the O.C.A. test and mathematics marks. The results are as follows:

| Test | Correlation |
|---|---|
| 1 (Arithmetic) | .31 |
| 2 (Word meaning) | .26 |
| 3 (Analogies) | .23 |
| 4 (Number series) | .23 |
| 5 (Reading) | .46 |

These figures are read: the arithmetic division of the O.C.A. test correlates .31 with mathematics marks, the word-meaning division

correlates .26, and so forth. Reading material has more value in predicting achievement in mathematics than has either the arithmetic or number-series material. Evidently, neither the arithmetic nor the number-series material in the O.C.A. test possesses much predictive merit in the field of mathematics.

*Rank displacement.*—The second procedure used to discover the predictive merit of the three intelligence tests, included in the study, was the method of rank displacement. The results obtained through the use of this method appear in Tables IV-VII inclusive.

Table IV records the amount of agreement which occurs when eighty students are assigned a quarter rank on the basis of Missouri

TABLE IV

AMOUNT OF AGREEMENT BETWEEN MISSOURI RATINGS AND GROUP INTELLIGENCE TESTS IN THE QUARTER PLACEMENT OF STUDENTS

| Number of Quarter Displacements | Missouri and O. C. A. | Missouri and Otis | Missouri and Terman |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 3 | 3 | 4 | 4 |
| 2 | 13 | 11 | 6 |
| 1 | 31 | 26 | 37 |
| 0 | 33 | 39 | 33 |
| Total | 80 | 80 | 80 |
| Mean | .83 | .75 | .76 |
| Median | 1.23 | 1.04 | 1.19 |

ratings and group intelligence-test scores. Reference to Column 2 will show how the table reads. The O.C.A. test agrees with the Missouri ratings in placing 33 students in the same quarter; 31 students are displaced one quarter, 13 students are displaced two quarters, and 3 students are displaced three quarters. The mean displacement is .83 of a quarter, and the median displacement is 1.23 quarters.

Analysis of Table IV shows that the best agreement in quarter placement exists between the Otis scores and Missouri ratings. The reader will note that disagreements amounting to two steps of quarter displacement occur much less frequently between Terman scores and Missouri ratings than between either O.C.A. or Otis

scores and Missouri ratings. When the eighty Freshmen were assigned a quarter rank on the basis of Missouri ratings, an equally high agreement in first-quarter placement was found with O.C.A. and Terman scores; in the second- and third-quarter placements, the best agreement was found with Otis scores; in fourth-quarter placement an equally high agreement was found with Otis and Terman scores. In only one instance did O.C.A. scores show more agreement with Missouri ratings than did either Otis or Terman scores. This was in the second quarter where the O.C.A. scores show a slightly better agreement than do the Terman scores.

TABLE V

PERCENTAGE AGREEMENT BETWEEN MISSOURI RATINGS AND GROUP INTELLIGENCE TESTS IN THE QUARTER PLACEMENT OF STUDENTS

| Quarter | Missouri and O. C. A. | Missouri and Otis | Missouri and Terman |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| First..... | .55 | .50 | .55 |
| Second..... | .40 | .50 | .30 |
| Third..... | .25 | .40 | .25 |
| Fourth..... | .45 | .55 | .55 |
| First and Fourth... | .50 | .53 | .55 |
| Total..... | .41 | .49 | .41 |

Table V records the percentage agreement that obtained when eighty students were assigned a quarter rank on the basis of Missouri ratings and group intelligence-test scores. Reference to Column 2 will indicate how the table should be read. Thus, Missouri ratings and O.C.A. test scores agree, in 55 percent of the cases, on the first-quarter placement of students; in the second quarter, the agreement is 40 percent; in the third quarter, 25 percent; and, in the last quarter, 45 percent. Agreement in the first and last quarters is 50 percent; in all quarters, 41 percent.

An analysis of Table V reveals several significant facts, one of which is that the best agreement exists between the Otis test scores and Missouri ratings when the total quarter placement is considered. A second fact is that the best agreement obtains between

Terman test scores and Missouri ratings when placement in only the first and last quarters is considered. A third fact revealed is that the Otis scores agree with the Missouri ratings in the placement of students in the middle quarters much better than do the O.C.A. or Terman scores, while a fourth point brought out is that agreement between intelligence-test scores and Missouri ratings is much higher in the first and last quarters than in the middle quarters.

Table VI shows the extent to which three group tests of intelligence agree in the quarter placement of these students. Reference to Column 2 will show how the table reads. The O.C.A., Otis, and Terman tests agree in placing 23 out of 80 students in the same quarter; 43 students are displaced one quarter, 13 students are displaced two quarters, and 1 student is displaced three quarters. The mean displacement is .9 of a quarter, and the median displacement is 1.4 quarters. Less agreement exists in the quarter placement of students when all three intelligence tests are concerned than when the quarter placement is made on the basis of the scores of any two of the tests. The best agreement is found between the Otis and Terman tests. About the same agreement is found between the O.C.A. and Otis tests as between the O.C.A. and Terman tests.

TABLE VI

AMOUNT OF AGREEMENT AMONG THREE GROUP INTELLIGENCE TESTS IN THE QUARTER PLACEMENT OF STUDENTS

| Number of Quarter Displacements | O.C.A., Otis and Terman | O.C.A. and Otis | O.C.A. and Terman | Otis and Terman |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| 3 | 1 | ..... | ..... | 1 |
| 2 | 13 | 9 | 7 | 2 |
| 1 | 43 | 31 | 35 | 33 |
| 0 | 23 | 40 | 38 | 44 |
| Total | 80 | 80 | 80 | 80 |
| Mean | .9 | .61 | .61 | .50 |
| Median | 1.4 | 1.00 | 1.06 | .91 |

Table VII records the percentage agreement that was obtained when eighty students were assigned a quarter rank on the basis of the scores on a group test of intelligence. Reference to Column 2 will show how the table reads. Thus, these tests agree, in 45 per-

cent of the cases, on the first-quarter placement of students; on the second-quarter placement, in 10 percent of the cases; on the third-quarter, 25 percent; and on the last-quarter, 35 percent. The agreement in the first and last quarters is 40 percent; in all quarters, 29 percent.

Much more agreement is shown in the quarter placement of students when any two of the intelligence tests are concerned than is the case when all three tests are considered. The best agreement in total-quarter placement lies between the Otis and Terman tests. The best agreement in upper- and lower-quarter placement lies between the O.C.A. and Otis tests; on the other hand, the best agreement in the middle quarters lies between the Otis and Terman

TABLE VII

PERCENTAGE AGREEMENT AMONG GROUP INTELLIGENCE TESTS IN THE QUARTER PLACEMENT OF STUDENTS

| Quarter Placement | O.C.A., Otis and Terman | O.C.A. and Otis | O.C.A. and Terman | Otis and Terman |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| First | .45 | .65 | .60 | .55 |
| Second | .10 | .35 | .20 | .70 |
| Third | .25 | .40 | .55 | .40 |
| Fourth | .35 | .60 | .55 | .55 |
| First and fourth | .40 | .63 | .58 | .55 |
| Total | .29 | .50 | .48 | .55 |

tests. The best single agreement is found between the Otis and Terman tests in the second quarter.

## SUMMARY AND CONCLUSION

1. Correlations show the Terman test to have a slight superiority over the Otis and O.C.A. tests in predicting scholarship. On the whole, the Otis test shows slightly more predictive merit than the O.C.A. The fact that the Otis and Terman tests are much easier to administer and to score than the O.C.A. lends significance to these statements.

2. Displacements in rank show, on the whole, that the Otis test is slightly superior to the Terman, and that the Terman test is

somewhat superior in predictive potency to the O.C.A. The greater ease of giving and scoring the Otis and Terman tests should again be taken into account in evaluating this statement.

3. All the group tests of intelligence predict achievement much better for students in the first and last intelligence quarters than they do for students in the middle quarters.

4. All the tests have more predictive reliability for students in the second intelligence quarter than they have for students in the third quarter.

5. The tests agree much better on the first and last quarter placement of students than they do on placement in the middle quarters. One interesting deviation from this statement is noted in the fact that the Otis and Terman tests agree best on second-quarter placement.

6. Careful study must be made to discover what types of test material possess most value in predicting scholarship. Certain types of material—analogies, arithmetic, number series, reading, and word meaning—seem to have much more predictive merit than have other types.

7. Investigation should discover what types of test material have most predictive merit in the various learning fields. A closer relationship exists between the reading material of the O.C.A. test and mathematics marks than between the arithmetic material of the same test and mathematics marks.

8. Investigation should discover how many types of material should be included in a test in order to obtain the most valid measure of intelligence. This study shows that the Terman test, which includes ten types of material, predicts achievement better than does the O.C.A. test, which includes five types of material. The greater predictive potency in favor of the Terman test results in spite of the fact that the O.C.A. test offers a much wider sampling of material within any test division and in spite of the fact that some of the Terman test elements compare unfavorably in predictive potency with the various divisions of the O.C.A. test.

# EDITORIALS

## THE GREAT EXPERIMENT

It is the favorite observation of certain writers and speakers that the future historians of our contemporary education will characterize the present period as an era of experimentation. Very likely those who thus wax prophetic are themselves interested in experimental education and attribute to it a significance beyond its just deserts. Whether the long backward look, with its inexorable application of the laws of perspective, will in fact see the resort to objective data as more than an episode, it is certain that the movement toward experiment in education is both suggestive and promising.

Moreover, it is essentially American. We do not mean that admirable experiments are not being conducted abroad. The names of a dozen men instantly come to mind—Englishmen, Germans, and even Antipodeans. The literature would be impoverished if the writings of these men were lost. It is likewise true that, in a number of foreign countries, there exist experimental schools as meritorious as any to be found in this country. When, therefore, we say that the experimental spirit is particularly American, we refer to experiment on a larger scale than the setting up of controlled experiments or even the organization of experimental schools.

In the late eighteenth century and the early half of the nineteenth, not many Europeans expected the American Republic to endure as a permanent state. Most of the comments upon us from such Europeans as Mrs. Trollope, Captain Hall, and Charles Dickens were quite uncomplimentary. Our energy was admitted. We had talent of a sort; but we were crude, self-opinionated, and vociferous. Of culture we had, so the critics said, nothing whatever except in our own estimation. Yet even in the judgment of unfriendly commentators we had one thing—a widely diffused system of education. If it was urged that our schools did not carry their students far toward a liberal training, it was nevertheless admitted

that our doctrine of equality had led us to place at the disposal of an astonishingly large part of our population the benefits of elementary schools.

Early in the life of a frontier people was planted the germ of an institution which constitutes a unique contribution to civilization. As this germ grew it developed into the present American public school, the like of which no nation now possesses. This is the great experiment, an experiment designed to establish the possibility of universal education at public expense.

We lose some undeniable advantages in making this demonstration. Our schools have obvious defects. They still are, as in the early days, too little concerned with real scholarship; and the love of learning is too little in evidence. We have too many subjects readily available in our course of study, and the elective system has undoubtedly gone too far in ministering to the caprice of students.

If, however, the great experiment has a chance to work itself out many of these defects will be remedied. We are still a young nation; our educational system is evolving. If we had been content in the beginning to adopt an aristocratic conception of education, if we had offered its benefits only to intellectual stalwarts, we should have had money and talent sufficient to develop a strong educational system in the European sense—a system geared to the training of literary, scientific, and artistic authorities. This would have been an easy task. We chose, however, to attempt the colossal undertaking of educating "everybody." If in trying to do this we have fallen short of the creation of an intelligentsia quite comparable to that of Germany, France, and England, it is entirely too early to say that we have chosen unwisely. Our choice has been to elevate the populace. We have taken a long hard way in our attempt to bring illumination to the people, but this way may yet prove to be not only the shortest, but the only way, home.

One unmistakable tendency is evident: we have succeeded in raising the level of general education. At first we merely had more children attending elementary schools, that is, more in proportion to population than any other country. The secondary schools and the universities were still the glory of Europe. We had our academies, it is true, and some of our colleges were excellent institutions,

but relatively few students attended them. Moreover, until fifteen or twenty years ago, men who sought the best university training of certain kinds had to go abroad to get it.

Gradually, however, while maintaining and even greatly extending educational opportunity, its general level was raised. Everyone is familiar with the astonishing development of the high school. This school, like other elements in our educational system, was something quite different from the European secondary school. It did not, like the European school, reach down past the upper grades of the elementary school and draw off the best talent. It began where the elementary school left off. It was a continuation of the elementary school; and as such it carried out the original idea of the great experiment. It became a part of the public-school system.

The upward thrust of education—the inevitable development of our great experiment—is still going on. The college and university have become involved. In 1890 the number of baccalaureate degrees granted was 6,800; in 1924 it was 61,000. In 1890 the number of Ph.D degrees was only 126; in 1924 it was 1,064. Young men now go to Europe for other reasons than to obtain advanced training.

If you ask that interesting chap called "the man in the street" what our greatest national achievement is, he may tell you it is in the automobile industry, or in the steel industry, or in aeronautics. It is in reality in none of these. Our greatest national achievement is not in medicine nor chemistry nor electricity. It is in education. Here is something which captivates the imagination—would if it were not as a matter of fact taken for granted—here is an undertaking which ministers directly to one-fifth of the entire population. It has its officers and executives not only in every city but at every crossroad. Its holdings are a principality.

As time passes the wisdom of the undertaking becomes apparent. The real reason why the red propaganda cannot stampede the American Federation of Labor is because the American workman is not like the workman in some other lands who is steeped in ignorance and fear and superstition. We are in the midst of whirling changes, of developments more rapid and more perilous to the social fabric than any age has known. Civilization is de-

veloping along non-biological lines. It has done so frequently in the past, but the civilizations of the past have perished. If we have any ground for the hope that our particular social structure will survive, that hope rests in universal education. It is the one thing which the societies that crumbled did not possess.

This is why we call the American public school unique. It is the hope of the nation. For its development no price in money or sacrifice is too great. It is our one universal business. It is the great experiment.

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EDITOR'S NOTE.—The last sentence of the paragraph ending near the top of page 164 in the October issue of this Journal should read: "Nevertheless, this distribution differs from the others only in degree. With this possible exception the facts indicate that we are dealing with something more than chance variations or the personal equations of the teachers."

B. R. B.

# NEWS and COMMUNICATIONS

Dr. John Guy Fowlkes has returned to the University of Wisconsin as Professor of Education following a year's leave of absence at the University of California.

Dr. Frederick Horridge, who was formerly Chairman of the Department of Vocational Education at Ohio State University, is now directing vocational education in the public schools of Long Beach, California.

Dr. J. R. Jewell has resigned as Dean of the College of Education at the University of Arkansas to accept an appointment as Dean of the School of Vocational Education, Oregon Agricultural College, Corvallis, Oregon.

Compass Survey Tests in Arithmetic, published by Scott, Foresman and Company, are now available for use. These tests are on two levels, Elementary for Grades II to IV and Advanced for Grades IV to VIII. There are two tests for each division designated as Forms A and B.

Dr. H. B. Smith who has been Superintendent of Schools of Lawrence, Kansas, and Professor of Education at the University of Kansas for the past seven years has resigned to accept a professorship in school administration at Syracuse University.

The inauguration of Dr. William Mather Lewis as President of Lafayette College occurred on October 20 and 21. Among the speakers were President Charles Russ Richards, of Lehigh University; Dr. George Olds, president-emeritus of Amherst University; Dr. Michael I. Pupin, of Columbia University; and Dr. John J. Tigert, United States Commissioner of Education.

The *Educational Research Bulletin* (Ohio State University) for October 26 was a special issue entitled "Directory of Building Material, Supply, and School Equipment Companies." More than seven hundred companies are classified under thirteen headings. The purpose of this directory, as set forth in the Foreword, is "to provide a ready means for the superintendent or other purchasing agent to ascertain quickly the names and addresses of companies dealing in a given equipment or supply item."

*New York Experiments with New-Type Modern Language Tests* by Ben D. Wood, of Columbia University, comprises the massive Volume I of "Publications of the American and Canadian Committees on Modern Languages" published by the Macmillan Company. This volume contains three reports: (1) the results of applying new-type objective tests to all students of French and

Spanish in the schools of New York city in June, 1925; (2) the administration of similar tests in French, Spanish, German, and physics in the Regents' Examinations in the State of New York—in this examination the period was equally divided between new-type and old-type tests; and (3) a second survey of achievement in French and Spanish in the junior high schools of New York city one year after the first survey. Among the conclusions drawn from Part II is the statement that, judged by the data of this experiment, the new-type examinations are roughly twice as reliable and valuable as the old-time examinations of equal-time allowance.

The Cincinnati Board of Education has adopted a new salary schedule which divides teachers into four groups:

Group 1. Those who have had two years of normal school preparation. These teachers will receive a minimum salary of $1,400, and may, by annual increments of $100 advance to a maximum of $2,000.

Group 2. Those who have had three years of normal school preparation. These teachers will receive a minimum salary of $1,500 and may, by annual increments of $125, advance to a maximum of $2,500.

Group 3. Those who are college graduates. These teachers will receive a minimum salary of $1,600 and may, by annual increments of $150, advance to a maximum of $3,250.

Group 4. Those who have the equivalent of a year of professional preparation in addition to four years of college training and who have served at least a year at the maximum of Group 3. These teachers will receive a minimum of $3,400 and a maximum of $3,500.

This schedule makes no distinction in standard qualifications between teachers of elementary- or high-school rank. Thus any teacher entering the system may advance through the higher groups to the maximum.

For the fourth consecutive year the *Yearbook of the Department of Superintendence* deals with the curriculum. During this period the yearbooks have dealt with *The Elementary-School Curriculum, Research in Constructing the Elementary-School Curriculum, The Nation at Work on the Public-School Curriculum,* and *The Junior High-School Curriculum.* The latter volume, the 1927 issue, is, like the earlier volumes, a product of the cooperative plan of curricular revision. During the year 1926-27 three hundred school systems and twelve national committees have worked under the Commission on the Curriculum. Parts I and II were prepared by the Research Division of the National Education Association, while Part III was prepared by the twelve national junior high-school committees. In addition to the strictly curriculum material appearing in the *Yearbook,* certain topics, such as "The Relation of the Junior High School to College Entrance Requirements," "The Source of Training and Salaries of Junior-High School Teachers," and "Junior High-School Costs" have been included because of their close relationship to the successful administration of the curriculum. This work has been done under the direction of Edwin C. Broome, superintendent of schools, Philadelphia, who is Chairman of the Curriculum Committee of the Department.

*A Laboratory Study of the Reading of Modern Foreign Languages* is the title of Volume II of the publications of the American and Canadian Committees on Modern Languages. This report was written by Dr. Guy T. Buswell of the University of Chicago, who carried on an extensive study of eye-movements of students learning to read a modern foreign language. By this means the growth in correct reading habits is clearly shown since the desired eye-movement in good reading is rhythmical without regression and with maximum distance between fixation points. The significant conclusions are that maturity of the fundamental reading habits which result from two years' study seems to be equal whether begun in high school or college, and that satisfactory reading habits are secured more effectively by the direct rather than by indirect method of translation.

Mr. E. P. Branson, director of Research, Long Beach, California, recently sent us the following data from the papers of 503 pupils selected at random from Grades IV-A to VIII-A, inclusive, out of four thousand Stanford Achievement Tests recently given.

MEAN SCORES AND STANDARD DEVIATION

| | Mean Score | Sigma |
|---|---|---|
| Computation | 101.6 | 21.0 |
| Reasoning | 65.5 | 17.8 |
| Total Arithmetic | 166.5 | 36.6 |
| Paragraph Meaning | 67.5 | 14.3 |
| Sentence Meaning | 45.2 | 13.9 |
| Word Meaning | 46.2 | 12.1 |
| Total Reading | 158.6 | 37.7 |

COEFFICIENT OF CORRELATION AND PROBABLE ERROR
PRODUCT-MOMENT METHOD

| | |
|---|---|
| Paragraph Meaning and Word Meaning | .79 ±.01 |
| Sentence Meaning and Word Meaning | .77 ±.01 |
| Paragraph Meaning and Sentence Meaning | .74 ±.01 |
| Computation and Reasoning | .70 ±.02 |
| Total Arithmetic and Total Reading | .58 ±.02 |
| Reasoning and Total Reading | .57 ±.02 |
| Total Arithmetic and Paragraph Meaning | .56 ±.02 |
| Reasoning and Paragraph Meaning | .55 ±.02 |
| Reasoning and Sentence Meaning | .53 ±.02 |
| Total Arithmetic and Word Meaning | .53 ±.02 |
| Total Arithmetic and Sentence Meaning | .52 ±.02 |
| Reasoning and Word Meaning | .50 ±.02 |
| Computation and Total Reading | .50 ±.02 |
| Computation and Paragraph Meaning | .48 ±.02 |
| Computation and Sentence Meaning | .48 ±.02 |
| Computation and Word Meaning | .47 ±.02 |

Toward the close of the last school year the *Review of Reviews* gave a test for the purpose of ascertaining the interests of the youth of the country and how these interests are satisfied. Large numbers of the test were distributed among the schools requesting it. Among the results procured were the following: A large percent of high-school students read only the comic page or sport section of the newspaper; high-school students generally know who is governor of their own state; Edison was identified by the largest

number and Valentino, Mrs. Coolidge, and Gertrude Ederle by smaller numbers in the order named, while Root, Hughes, and Queen Marie fell hopelessly behind; the claim to fame of Ty Cobb, Aimee McPherson, Gene Tunney, and Suzanne Lenglen is known to about one-third of those tested, while Bernard Shaw, Leonard Wood, and Parkes Cadman were identified by only a small group; reparations are generally a mystery and to many Nicaragua is in South America, Mexico, or Panama. The magazine raises the question whether the interests of youth can be more advantageously directed in the school or in the home.

Twenty thousand dollars has been appropriated by the West Virginia Legislature with which to make a study of the administration of elementary schools, high schools, and institutions of higher learning in the State. Dr. L. V. Cavins, of the Bureau of Investigation and Statistics of the State Department of Education, is directing the study, assisted by an Advisory Committee consisting of Dr. Charles H. Judd and Dr. George A. Works, of the University of Chicago, and Dean John W. Withers and Dr. Paul V. West, of New York University. In addition to the Advisory Committee, a Committee on Higher Education has been appointed. The local staff consists of fifteen members, most of whom are engaged in educational work within the State. The field work of the survey was begun during the month of September and the testing program carried on during the months of October and November.

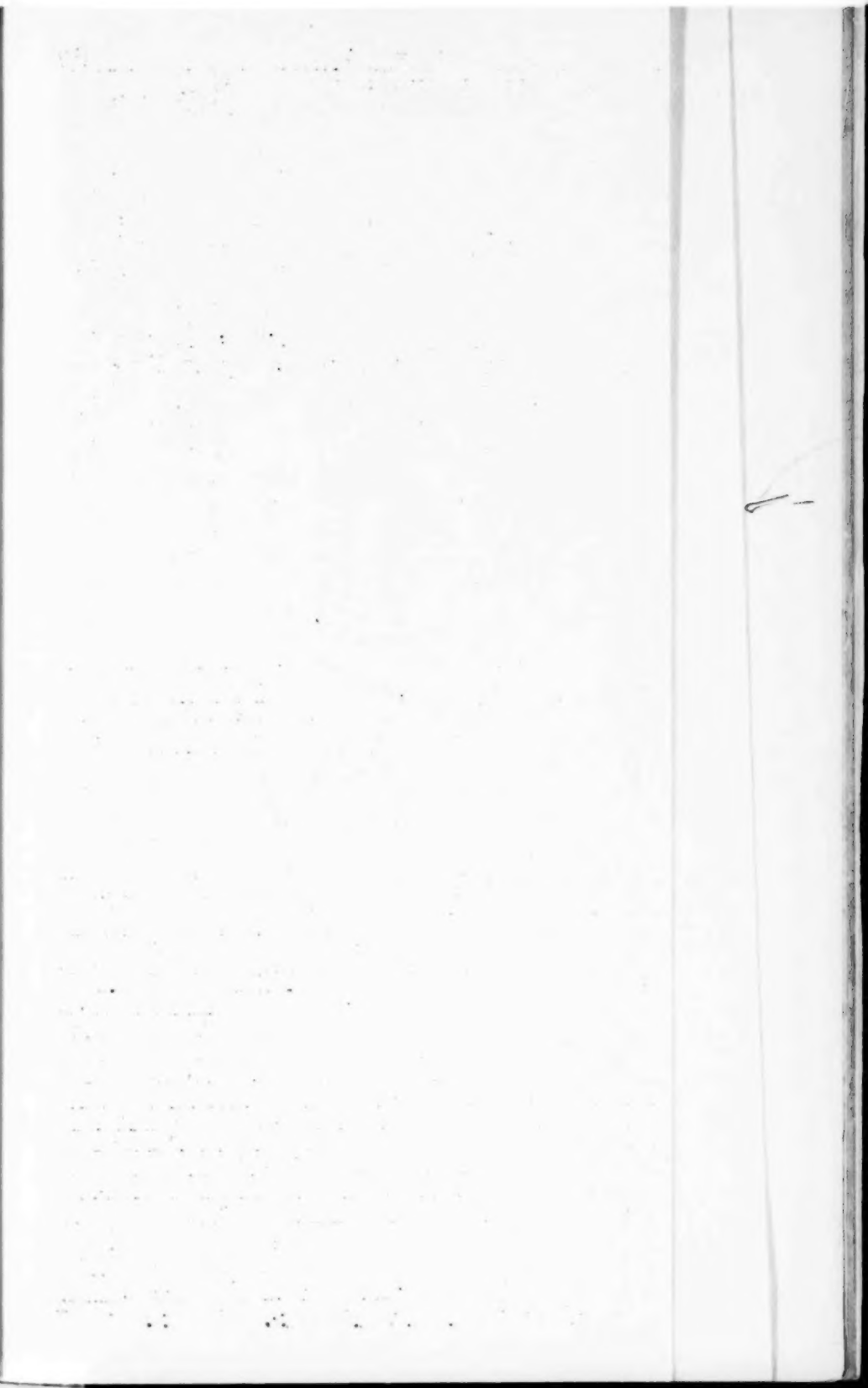
## AN ABAC FOR DETERMINING THE PROBABLE CORRELATION OVER A LARGER RANGE KNOWING IT OVER A SHORTER ONE

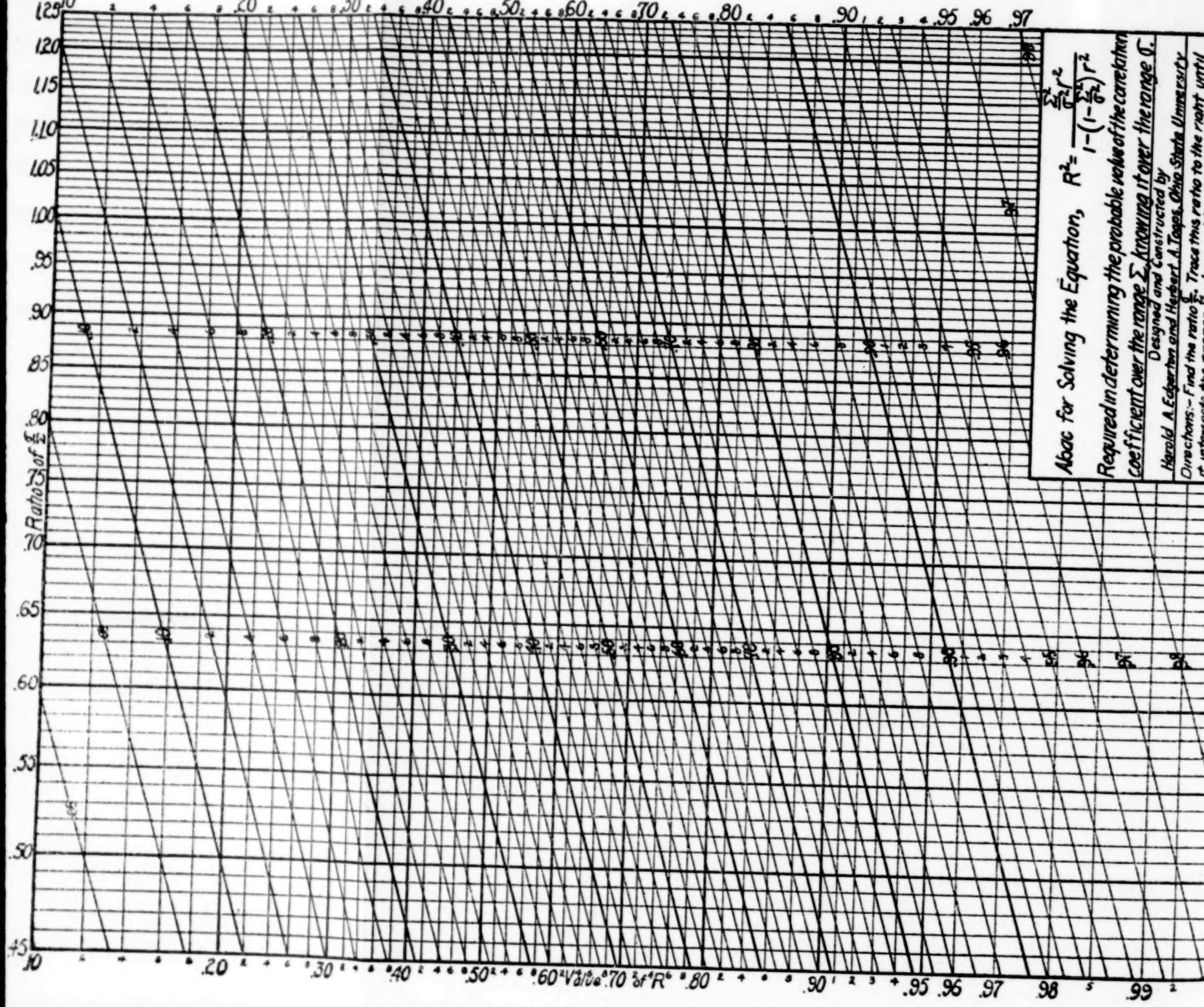
In sectioning, and in many other cases as well, we often have one large group divided into two or more smaller groups of more homogeneous ability. Knowing a correlation coefficient in one of these relatively homogeneous groups, we desire an estimate of the magnitude of the correlation coefficient in the heterogeneous group.

Experience tells us that the same basic relationship between intelligence and marks, for instance, may be represented in the successive grades by progressively lower validity coefficients as larger proportions of the school population are eliminated by failure and voluntary dropping. Dr. Kelley has furnished us with a formula for solving such problems, of which the following is an example:

A group of 75 pupils, with standard deviation of intelligence of 25, is split into X, Y, and Z sections. In the Z section, consisting of all pupils scoring below 40 on the tests, standard deviation of intelligence of 15, the correlation between marks and intelligence is .40. What is the best bet we can make in regard to what would have been the correlation in the entire group of 75 pupils?[1]

[1] Kelley, T. L. *Statistical Method*. New York, Macmillan Company, 1923. p. 225. Formula No. 186.




Abac for Solving the Equation, $R^2 = \frac{\sum_1^n r^2}{1-(1-\frac{\sum_1^n}{\sigma^2})r^2}$
Required in determining the probable value of the correlation coefficient over the range $\Sigma$, knowing it over the range $\sigma$.
Designed and Constructed by
Harold A. Edgerton and Herbert A. Toops, Ohio State University
Directions:- Find the ratio $\frac{\Sigma}{\sigma}$. Trace this ratio to the right until
Ratio of $\frac{\Sigma}{\sigma}$
$^2V\sqrt{1/v_e}$
$^3\sqrt{f^4R^6}$

To solve this problem we substitute, $\sigma = 15$; $\Sigma = 25$; $r = .40$ in the following formula and solve for $R$:

$$R = \frac{\frac{\Sigma}{\sigma} r}{\sqrt{1 - r^2 + r^2 \frac{\Sigma^2}{\sigma^2}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

For convenience in solving, this may be written in a form which avoids the radical sign,

$$R^2 = \frac{\frac{\Sigma^2}{\sigma^2} r^2}{1 - \left(1 - \frac{\Sigma^2}{\sigma^2}\right) r^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Substituting the values of the above problem:

$$\frac{\Sigma}{\sigma} = \frac{25}{15},$$

$r = .40$, and

$$R^2 = \frac{\frac{625}{225}(.16)}{1 - \left(1 - \frac{625}{225}\right)(.16)}$$

$$= \frac{.444}{1.284}$$

$$R = \sqrt{.3457}$$

$$= .59$$

That is to say, a correlation of .40 in the Z group indicates the same degree of relationship as would the larger correlation coefficient of .59 in the entire group.

*Construction of the abac.*—To use the formula for the construction of an abac we have solved for $\frac{\sigma^2}{\Sigma^2}$ thus:

$$\frac{\sigma^2}{\Sigma^2} = \left(\frac{1}{1 - r^2} - 1\right)\left(\frac{1}{R^2} - 1\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Taking logarithms of both sides,

$$\log \frac{\sigma^2}{\Sigma^2} = \log \left(\frac{1}{1 - r^2} - 1\right) + \log \left(\frac{1}{R^2} - 1\right) \ldots\ldots (4)$$

or,

$$Y = K + Z, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

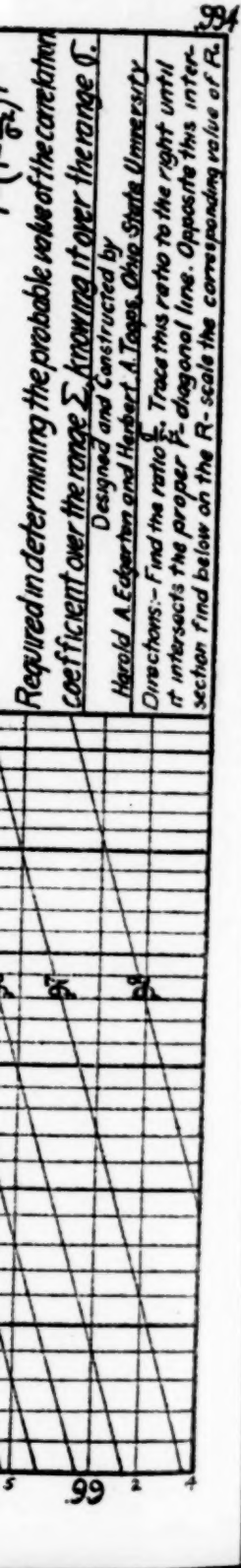
If $Y$ be ordinates of equal parts representing logarithms and $Z$ be abscissae of equal parts representing logarithms (neither shown in the abac) and $K$ be a parameter determined by the value of $r$, the locus of equation (5) is a family of parallel curves, shown in the abac. The position of landmark values of $\frac{\sigma}{\Sigma}$ and of $R$ have been determined and these make up the coordinates of the abac, the original logarithms from which these were constructed not being reproduced in the drawing from which the zinc engraving was constructed.

As a check on the numerical work in finding logarithms, $r$ becomes $R$ when $\frac{\sigma}{\Sigma}$ becomes 1,

hence,

$$\log f(r)]_{r = k_1} + \log \Phi(r)]_{r = k_1} = 0 \ldots\ldots\ldots (6)$$

is a useful check on the correctness of the logarithms used in plotting the


Required in determining the probable value of the correlation coefficient over the range Σ, knowing it over the range σ.
Designed and Constructed by
Harold A. Edgerton and Herbert A. Toops, Ohio State University
Directions:- Find the ratio σ/Σ. Trace this ratio to the right until it intersects the proper r- diagonal line. Opposite this intersection find below on the R- scale the corresponding value of R.
.99
.99

abac. The peculiar form of equation (4) was taken in order to utilize to the utmost the assistance of tables of squares and of $(1-r^2)$.

*Use of the abac.*—To solve the above problem on the abac: (1) Find the ratio,

$$\frac{\sigma}{\Sigma} = \frac{15}{25} = .6.$$

(2) Trace the .6 — ordinate to the right until intersecting the $r = .40$ diagonal line. At the foot of the chart read $R = .59$.

When $\frac{\sigma}{\Sigma}$ is less than 1.00 the value of $R$ will be larger than $r$; and when $\frac{\sigma}{\Sigma}$ is greater than 1.00, $R$ will be smaller than $r$ and a reduction in the value of $r$ will result upon applying the formula. All ratios of $\frac{\sigma}{\Sigma}$ between .45 and 1.25 inclusive are shown on the chart. The values of $R$ corresponding to the ratios of 1.26 to 2.22 inclusive can also be found by the following indirect method:

1. Find the ratio $\frac{\Sigma}{\sigma}$.

2. In imagination interchange the labels $r$ and $R$, thus making diagonal lines be $R$ and abscissae $r$. Using the $\frac{\Sigma}{\sigma}$ ratio on the ordinate scale, and using the two imaginary labels for $r$ and $R$, find the value of the $R$ diagonal line which is located at the intersection of the $\frac{\Sigma}{\sigma}$ ordinate and $r$ abscissa.

Example:

$\sigma = 5.0$; $\Sigma = 2.5$; $r = .60$. What is the value of $R$?

(a) $\frac{\Sigma}{\sigma} = .5$. This ordinate is located at the $\frac{\sigma}{\Sigma}$ ratio of .5.

(b) Locate the $r$ of .60 on the abscissa axis at $R = .60$ by the interpolation of the value of the diagonal line which would pass through this point.

(c) At the intersection of these two coordinates find $R = .35$. That is, in the reduced range where $\Sigma$ is only 2.5, a correlation of .35 indicates the same basic relationship as $r = .60$ in the larger range where $\sigma = 5.0$.

*A special case for use of the abac.*—At Ohio State University, the intelligence scores are reported both as percentiles and as classes, determined on a percentage-receiving basis, as follows:

| Class | | Percent Receiving |
|---|---|---|
| I. | Very superior students | 5 |
| II. | Superior students | 20 |
| III. | Average students | 50 |
| IV. | Inferior students | 20 |
| V. | Very inferior students | 5. |

If we compute the standard devintion of such a random group, it will always be $\sqrt{.8}$, thus:

| $X$ | Fr | $X$.Fr | $X^2$.Fr |
|---|---|---|---|
| 1 | 5 | 5 | 5 |
| 2 | 20 | 40 | 80 |
| 3 | 50 | 150 | 450 |
| 4 | 20 | 80 | 320 |
| 5 | 5 | 25 | 125 |
| Sums | 100 | 300 | 980 |
| | $N$ | $\Sigma X$ | $\Sigma X^2$ |

$$\Sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N^2}} = \sqrt{\frac{(100)\ (980) - (300)^2}{(100)^2}} = \sqrt{.8}$$

Hence

$$\frac{\sigma^2}{\Sigma^2} = \frac{\sigma^2}{.8} = 1.25\sigma^2.$$

In any course taught by a given instructor the ratio of $\frac{\sigma}{\Sigma}$ will be either less than 1.00 or more than 1.00 according as his class is made up of a range of intellectual talent less than that contained in a random group of entering students, or a range of intellectual talent greater than that contained in a random group of entering students respectively. Ordinarily $\frac{\sigma}{\Sigma}$ is less than 1.00 and particularly in the case of advanced courses in which Class IV and V students are largely absent through early elimination from the university. Ratios of $\frac{\sigma}{\Sigma}$ greater than 1.00 can come about only by having in a section disproportionate numbers of students of extremely high or low capacity relative to the numbers at intermediate abilities. Such cases seldom occur.

The use of the formula enables one to make an estimate of whether an $r$ of .40 in an advanced class made up primarily of superior students is as high a relationship as a larger $r$ in a freshman class of unselected students. That is, all $r$'s between intelligence and marks in the case of particular sections, instructors and departments may be readily transmuted to a common basis of "What would be the probable $r$ in this section if the section consisted of a *random* grouping of all degrees of talent in the proportions in which they enter the University?" Having found the standard deviation of a given section in intelligence which we shall call $\sigma$, the ratio,

$$\frac{\sigma}{\Sigma} = \sqrt{1.25\sigma^2} = 1.1180\sigma \qquad (7)$$

is an extremely convenient way of determining the ratio necessary for the use of the abac. The standard deviation of intelligence in the particular section is multiplied by 1.1180 giving us the ratio with which we enter the chart and determine $R$ directly. A table giving all the values of equation (7) corresponding to all the most frequently occurring values of $\sigma$ can readily be constructed in a few minutes' time with the aid of a calculating machine.

HERBERT A. TOOPS
AND
HAROLD A. EDGERTON

*Ohio State University*

Erratum: Professor Michael Wen, principal of Teachers Training College, Dacca, Bengal, calls our attention to an error which appeared in connection with a handwriting scale reproduced on the inside of the back cover of the February issue of the Journal. It is described as a handwriting scale used in Burma, but it should have been called a handwriting scale devised in Bengal. The language in Burma is Burmese—an entirely different script—which bears no relation whatever to the Bengal language.

# REVIEWS

BOWEN, W. P. *Conduct of Physical Activities.* New York, A. S. Barnes and Company, 1927. 173 pp.

This is a desirable book for a personal library and one that should be of great help to the classroom teacher who may have physical activities to conduct. The classification of activities is good, the short bibliography at the end of each chapter is a helpful feature, and the "Topics for Discussion," also at the end of each chapter, increase the value of the book as a text.

There might be some disagreement with the author in his statement that "the technique of the teaching of gymnastic movements is the simplest of all," and that classwork should always be done in unison. His suggested system of symbols for gymnastic exercises seems rather complicated and quite a departure from the standard so generally accepted for many years.

Ten chapter headings are well chosen to cover a comprehensive field of activities. This book can be recommended as a good reference, at least, if not as a textbook, for a course in physical education.

J. H. NICHOLS

*Ohio State University*

BUTTERWECK, JOSEPH S. *The Problem of Teaching High-School Pupils How to Study.* New York, Teachers College, Columbia University, 1926. vi + 116. (Teachers College, Columbia University, Contributions to Education, No. 237)

This monograph reports the results of an experiment in teaching high-school pupils how to study. One method consisted in instructing pupils in the best methods of study, without practice, and the other involved "practice material in the elements of certain study situations and just enough direction in the use of these materials to insure reasonable efficiency in their use."

The two methods were employed in the solution of originals in geometry, in reviewing for certain examinations, and in reading for purposes of studying. The results in geometry indicated a general superiority of the practice method over the instruction method, although this superiority was confined to the average and lower levels of intelligence. With pupils of high intelligence the practice method was little, if any, better than the non-practice method. The same conclusions followed for reading: "the ability of pupils in selecting facts is not improved by either method of instruction, but rather their ability to read with logical organization in mind." The practice method likewise retained its superiority in the case of reviewing for examinations but not to the same degree as in geometry and reading. Here, too, results differed as

between pupils of low and average intelligence and those of high intelligence. Finally, in their effects upon grades in other school subjects it was found that the informational method had no significant effect, while the results of the practice technique were restricted almost entirely to pupils of below-average intelligence. Once more the non-practice technique revealed a marked effect only upon pupils in the highest quarter of intelligence.

While this study is inconclusive in a number of particulars, it does reveal the necessity of adapting methods of study to individual differences. It likewise indicates the wisdom of concentrating upon the study habits of pupils within each subject in contrast to a dependence upon a transfer of study procedures from how-to-study classes to the particular subjects of the curriculum.

V. T. THAYER
*Ohio State University*

MATHEWS, C. O. *The Grade Placement of Curriculum Materials in the Social Studies.* New York, Teachers College, Columbia University, 1926. vi + 152 pp. (Teachers College, Columbia University, Contributions to Education, No. 241)

The work may be characterized as a demonstration of the application and significance of methods of measurement to the construction of the curriculum. For the purposes of the study seventy-two samples were selected showing a variety of content, from sources such as newspaper articles, maps and bar diagrams. To determine the extent to which the content could be grasped by pupils of the different grades, several tasks or questions of an objective sort were devised in connection with each sample and expressed within the reading vocabulary of fourth-grade children. On the basis of responses from approximately 2,350 pupils in Grades IV through XII, representing every section of the country and school systems of all sizes, the grade difficulty at which 50 percent, 67 percent, and 75 percent of the content of each sample could be comprehended was determined. Only a reading of the book, which contains the samples and their difficulty-values or grade-placements, can give one a clear notion of the significance and value of the study. The statistical method by which the results were derived is clear-cut and sound. The measures of difficulty expressed in terms of the grade at which a definite proportion of the content could be grasped, leave little room for misinterpretation or uncertainty of meaning. To the general reader the results might have been more convincing if the author had shown the high reliability of the grade-placements and the small variations due to different sections of the country, facts which are evident to the statistician from other work that has been done.

Either through modesty or an attitude of waiting for someone else to point out the significance and implications of his study, the author contents himself with pointing out some further problems for investigation. The educationalist, however, must give serious consideration to its findings in both the construction of the curriculum and textbook-making. Dr. Mathews has demonstrated the necessity of taking the abilities of children into account in selecting and arranging the content of a curriculum or a course of study. Without doing

so, no valid claim can be laid to a scientific procedure, nor can any author of a textbook in reading geography or history afford to overlook the necessity for determining the difficulty of the content for the pupils for whom it is intended without incurring the criticism of neglecting one of the important functions of textbook-writing or disregarding scientific achievement in education. The book deserves wide reading; it sets up new standards and criteria in the construction of the curriculum and in textbook-making.

M. J. VAN WAGENEN

*University of Minnesota*

RUCH, G. M., and STODDARD, GEORGE D. *Tests and Measurements in High School Instruction.* Yonkers-on-Hudson, New York, World Book Company, 1927. xix + 381 pp.

From the beginning of the standardized test movement, many of the tests and scales prepared have been adaptable to high-school use; but, for various reasons, the movement during the earlier stages was most emphasized in the elementary schools. This emphasis was naturally reflected in the books written concerning the use of tests. More recently there has developed a marked interest among secondary-school people in the use of standardized and objective measurement. Yet, until this book appeared there was no single publication written exclusively for the use of high-school teachers and administrative officers.

The authors have brought in this volume a careful and discriminating general discussion of the uses and limitations of tests in high schools; a scientific description of the secondary-school tests by subjects such as English, science, and foreign language; and an analysis of the uses which may be made of objective examinations, and of the technique involved in the construction of educational and mental tests.

The authors have succeeded unusually well in bringing to their description of the tests all the evidence that has been published concerning the validity, reliability, norms and other technical features of the tests available for high-school use at the time the book went to the publishers. From no other source can the prospective user of these tests secure such accurate and adequate information concerning their validity and reliability as this volume gives.

In their attempt to be scientifically accurate, the authors have in reality leaned backward in pointing out the limitations of standard tests. Their treatment of this aspect of measurement is a beautiful illustration of carrying a virtue to the point where it becomes a vice. All they have written on this issue is true, but too often they have failed to record the positive value of the test. The natural result of this one-sided emphasis, in the opinion of the reviewer, is a book which will be welcomed by serious students of the educational measurement but which will fail to inspire the rank and file of teachers to secure a more intimate and adequate acquaintance with the new set of tools already available for use in improving high-school instruction.

The book will make an excellent text for college and university classes studying measurement in secondary schools, and it can be strongly commended

to all high-school principals and teachers who are seeking earnestly to improve their instructional service through the use of scientific method.

J. CAYCE MORRISON
*Assistant Commissioner of Education,*
*The University of the State of New York*

BRACE, DAVID KINGSLEY. *Measuring Motor Ability.* New York, A. S. Barnes and Company, 1927. xvi + 138 pp.

Although scientific measurements have been employed for many years in physical education, they were directed, generally, toward structural quantities. Anthropometry has been used always by physical educators but especially since the work of Hitchcock and Sargent. The recent interest in measurement of intelligence and mental accomplishments found physical education quite unprepared to use and appreciate the new techniques and statistical methods until this study by Brace was made.

The book is a careful scientific experimental study of motor ability. Thirty tests were selected out of a larger list used in different groups. Instruction is given in administering the tests; and discussion of validity, reliability, and objectivity are characteristics of the tests. The tests used were scaled, and the results employed in the developing of a scale of motor ability. The Brace Scale of Motor Ability is well arranged in a separate section of the book; it is illustrated adequately and contains full directions.

The book is well printed in plain type, and the format is pleasing. This is a study that should be in the hands of every thinking teacher of physical education; many specialists in educational tests and measurements will wish to see the results of study in this field.

JESSE F. WILLIAMS
*Columbia University*

COX, PHILIP W. L. *Creative School Control.* Philadelphia, J. B. Lippincott, 1927. ix + 320 pp.

This book makes a real contribution in the encouragement which it gives to all those interested in the social life of the school; written by one experienced in actual school leadership, it is practical and challenging. It shows that a junior and senior high school need not be controlled by repression of the over-abundant and effervescing energy of youth but that the best form of control results from the expression of this energy in activities that are socially valuable and which develop individual power, self-control, and social consciousness.

Dr. Cox gives one concrete illustration after another of how children learn by doing, and how creative school control can be realized through home-room activities, classroom procedures, athletics and physical recreation, clubs and societies, assemblies, student publications, and student participation in school administration. A chapter devoted to each of these pupil activities, followed by a selected bibliography, shows how through them the life of the school is enriched and for every pupil participating there is satisfaction and self-realization. In other words, student activities in order to be wholesome need

not be tiresome, for they can be educational, joyous, creative, self-satisfying, and socially valuable. The question ever before the teacher is this: "How shall the school affect conduct so as to contribute most to the desired social order?"

So important is the question, "What sort of teacher is required for creative school control?" that the author does not leave the answer to the reader. He writes:

> Here then is the equipment that all who are to undertake this magnificent venture must have: adequate, applicable, dynamic knowledges of sociology, psychology, and methodology, a pioneering spirit, and a brave philosophy of life. These five—and the most important is the philosophy. For without a whole-souled intelligent belief that the schools can discover and put into operation methods essential to democracy, and a sober determination to find such methods, the pioneering spirit will lead only to noisy, headless activity, and the knowledges of educational sciences will be inert and abstract.

As forward-looking teachers, parents, and community leaders secure this equipment, they together with the boys and girls will create a new school control of human behavior. This new education is a preparation for a social world now in the making.

MARGARET M. ALLTUCKER

*Assistant Director, Research Division,*
*National Education Association*

CHARTERS, W. W., LEMON, A. B., and MONELL, L. M. *Basic Material for a Pharmaceutical Curriculum.* New York, McGraw-Hill Book Company, 1927. xiii + 366 pages.

When representatives of a profession cease to spend most of their energies in committee meetings striving to determine curricular needs by consensus and turn their efforts into channels of cooperative study by scientific methods, they can expect to arrive at basic conclusions which are superior to their best guesses. *Basic Material for a Pharmaceutical Curriculum*, the product of this type of intensive group work, conclusively exemplifies this belief of the reviewer.

The cooperative undertaking on the part of the American Colleges of Pharmacy, the National Association of Retail Druggists, and the National Association of Boards of Pharmacy resulted in a curricular study made under the direction of an educational pioneer in scientific curriculum construction collaborating with pharmaceutical experts. Techniques employed in the researches included critical analyses of thousands of prescriptions, personal interviews with leading faculty members and practicing pharmacists, analysis of pertinent national and state laws, analyses of inventories of retail pharmacies, questionnaire study of practical experiences, statistical study of poisoning cases, and utilization of expert consensus in public health. The formidable array of data thus accumulated was classified and organized and, in some cases, integrated until they were made to yield conclusive facts regarding the activities, duties, needs, and responsibilities of the pharmacist.

The findings were summarized and sections of the reports then edited by persons so technically trained that they knew the significance of the materials.

The outcome is a report of the basic materials of a pharmaceutical curriculum in which students need to be trained in preparing to enter the profession of pharmacist. The subject-matter needed in pharmacy, materia medica, chemistry, physics, and commercial pharmacy is presented. Under the heading of pharmacy are included such phases as compounding and dispensing, English, jurisprudence, mathematics, Latin nomenclature, operative pharmacy, practical experience, preservation, professional morale, and techniques involved in compounding, dispensing and operative pharmacy.

The volume is a distinct contribution to curriculum-building in the field of higher education. It exemplifies many techniques of curricular research which might be applied very profitably to discover what to teach in other professional fields.

*University of Michigan* GEORGE C. KYTE

UHL, WILLIS L. *Secondary-School Curricula.* New York, Macmillan Company, 1927. xx + 582 pp.

In writing this book Dr. Uhl has performed an invaluable service for students of secondary education. Many, if not most, of the curricular studies of recent years have been limited in historical perspective or have presented programs of reconstruction without grounding these programs consciously upon fundamental principles. *Secondary-School Curricula*, however, surveys the historical development of the secondary-school curriculum and thus gives an adequate setting for its comprehensive account of contemporary methods and procedures.

Part I begins with a discussion of "curriculum practices" in primitive life and traces the character of secondary-school studies in ancient Greece, Rome, Mediaeval Europe and modern times down to the reorganization movement of the nineties. Part II reviews the criticisms to which the secondary-school was subjected in these periods, thus revealing how intimately the curriculum has reflected the dominant intellectual concerns of the ages as well as the major objectives which have evolved out of the practice of the past.

Professor Uhl believes that curricula must be constructed and administered in the light of four principles, "history and criticism, objectives, pupils, and local conditions." Accordingly, beginning with Part III, the book concentrates upon the last three principles. Part II deals with modern objectives. Part IV treats of "Pupils and Curricula" (pupil equipment, pupil interests, pupil needs), Part V with "Curricula and Local Conditions," and Part VI with "Present-Day Curricula." In these sections Professor Uhl summarizes more suggestively recent studies and investigations bearing upon the organization of curricula. No one interested in secondary education can afford to ignore the advantages which Professor Uhl has so industriously placed at his disposal.

*Ohio State University* V. T. THAYER

FRIES, CHARLES C. AND OTHERS. *The Teaching of Literature.* New York, Silver, Burdett and Company, 1926. iv + 172 pp.

*The Teaching of Literature* discusses with admirable brevity and urbanity the work of the teachers of English literature in the high school of the various aims, numerous and plausible, which have been set up in the past as all-compelling, the authors advocate as best definitive of the literary field, "the expansion of the pupil's experience of life." The phrase is used both in the Croce sense of purely aesthetic experience and in the much more inclusive Arnold sense of general culture.

Thus, literary experiences include a vivid realization by the pupil of actions, in which he lives the story; conduct problems, in which he criticizes life; background, where he recovers, in imagination, past or present ways of living; characters and their explanation, from which he infers motives; emotions of people in crises, when he feels their thrills; the personal emotion of the writer, when he reaches sympathetically the lyric moment of intuition; thought stimulus, when he feels the exhilaration of ideas; or of the significance of the common-place, which causes him to find new meanings in the little things of life. The list does not profess to be complete. Literature has other ministries, but those given are possible for ninth- and tenth-graders. They prove that the study has its own field and purpose and is not to be thought of as primarily pursued in the interest of "Democracy," "service," or "morals."

Emphasis is properly placed upon the presentation of backgrounds for appreciation. The unique quality of a piece of literature is to be sensed only when the right basis for apperception is supplied. The chief work of the teacher is right here, according to our authors, and they propose for the eleventh year a survey course in which pieces of literature are to be read in the order of the historical backgrounds required for their appreciation. This clearly offers advantages over the order usually followed in histories of English literature and is worlds ahead of the haphazard reading of old and new masterpieces with not much more in view than a pleasing variety.

The final phase of study suggested is the study of types with a much needed warning against categorical and technical treatment. A chapter on contemporary literature advises caution, thought, and careful selection, but recognizes the futility of completely ignoring the literary expressions of the periods in which our pupils are living their lives and getting their experience.

The scope of the work does not permit specimen lessons, such as the younger teacher covets, but scattered through the volume are many useful hints of specific treatment. The authors have almost invariably indicated the one indispensable thing to teach in connection with each piece of literature named.

J. V. DENNEY

*Ohio State University*

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